TABLE OF CONTENTS

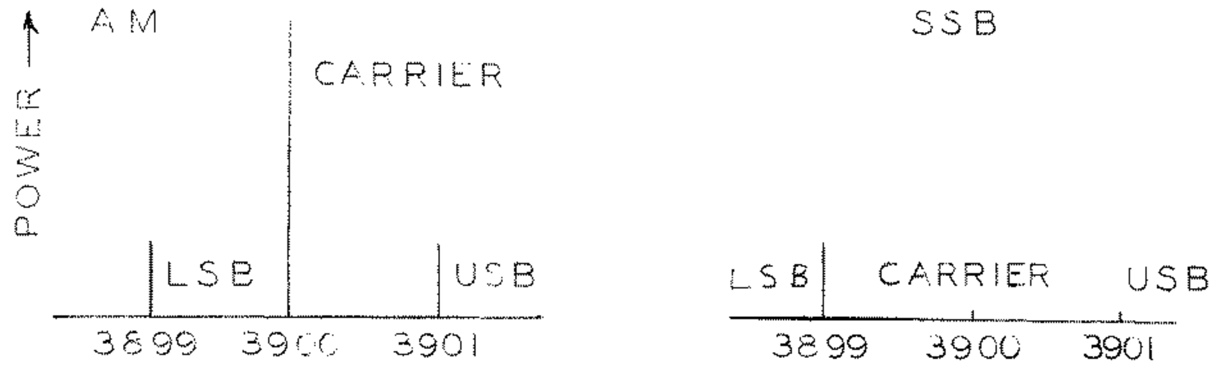
1. INTRODUCTION AND OPERATION

SB-34 TRANSCEIVER

1.1 INTRODUCTION TO SSB

The idea that an amplitude modulated signal was an indivisible whole prevailed until the year 1914, when it was established mathematically that a wave of this type could be divided into a carrier and two equal sidebands which appear above and below the carrier by an amount determined by the modulating frequency. A year later, the U.S. Naval Radio Station in Arlinton, Virginia, began conducting experiments employing an antenna tuned to pass one sideband and attenuate the other. From these experiments, it was learned that one sideband alone contained all the elements necessary for voice transmission. In the years following this discovery, SSB progressed slowly. World War II contributed much to the advancement of electronic technology, and consequently SSB circuit requirements, such as the mechanical filter, became practical and economical. Continued advances have refined techniques to the point where SSB has become a dominant mode of radio communication.

To provide the same coverage as an AM system, an SSB transmitter requires a substantially smaller power rating. This may be seen by a comparison of the power distribution between a 100% modulated AM wave and a single sideband transmission. In a standard AM transmitter with 100 watts of carrier power, each sideband will contain 25 watts. The total power required for this type of transmission will be the sum of the upper and lower sidebands, (25 watts USB and 25 watts LSB), plus the carrier (100W) equalling 150 watts peak power. Since only one sideband is needed to convey the intelligence of the signal, a 25 watt single sideband signal transmitted alone will provide the same coverage as the 150 watt system. In SSB equipment, we are able to transmit only one sideband and we can realize a great saving in size, weight and cost of the transmitting equipment. Another practical advantage of SSB is conservation of the frequency spectrum. This method of transmission has demonstrated the ability to double the number of voice channels within a given frequency range as compared to conventional A.M.



1.1.1 Comparison of AM and SSB Spectra

A final consideration is the elimination of carrier heterodyning so frequently found in standard AM transmissions.

1.2 SB-34 TRANSCEIVER SPECIFICATIONS

Type of Emission:	Single sideband, suppressed carrier, upper or lower sideband selectable from front panel
Frequency Range:	3.775 - 4.025 mc, 7.05 - 7.3 mc, 14.1 - 14.35 mc, 21.25 - 21.45 mc
Power Consumption:	117 VAC - receive 35 watts - transmit (single tone) 165 watts 12 VDC - receive, XMTR switch off, 0.6 amps - receive, XMTR switch on, 3.6 amps - transmit (single tone) 14 amps
Power Output (PEP):	80, 40, 20 meters: 60 watts minimum 15 meters: 50 watts minimum
Carrier Suppression:	50 db
Unwanted Sideband Suppression:	40 db at 300 cycles
Distortion Products:	Down at least 25 db
Spurious Responses:	Down at least 40 db
Antenna Output Impedance:	40 - 100 ohms, unbalanced, VSWR not to exceed 2:1
Sensitivity:	Less than 1 microvolt for 10 db signal-to-noise ratio, all bands
Selectivity:	2.1 kc at 6 db down, 4.5 kc at 60 db, both transmit and receive
Audio Output:	2.0 watts at 10% distortion, 3 watts maximum
Dimensions:	5" high, 11 1/8" wide, 9 1/2" deep
Weight:	Approximately 18 pounds

1.2.1

The SB-34 is a complete, self-contained SSB transceiver for operation on four amateur bands, 80-40-20-15 meters; requires only a microphone, antenna and primary source of power.

This is advanced-design communications equipment using transistors throughout to replace vacuum tubes with the exception of those in RF Driver and Final Amplifier stages.

Through extensive application of solid-state elements, (eliminating vacuum tube heaters) overall current drain is lowered, operation is cooler, life expectancy longer. Performance is equal to, in many cases better than equipment using vacuum tubes. Exceptional selectivity is provided by a mechanical filter.

Bilateral amplifiers and mixers use common circuits both on transmit and receive and operate by controlling direction of amplification. In the SB-34 bilateral stages are used to process both the transmit and the received signal. By using this principle, we realize a saving in size and cost as well as eliminating circuit duplication.

1.3 CONTROL FUNCTIONS

The various front-panel controls and their functions are described in detail in the following paragraphs. Make certain that you understand the function of each control before attempting to operate the transceiver. Detailed instructions are given for tuning the transmitter. The design of the unit is such that when the transmitter is properly tuned, the receiving portion of the set is also properly aligned to the frequency in use.

1.3.1 Volume Control. The power ON/OFF switch and volume control functions are combined on a single control knob located at the lower left corner of the front panel.

A unique AGC system is incorporated in the SB-34. As the volume control is advanced, strong AGC action occurs as the set reaches normal room volume. From this point on, the volume remains substantially constant until the control is about three-quarters advanced. Beyond this point, the volume rises rapidly until full audio output is obtained with the control fully clockwise. For home use, the volume control is normally operated in the first half of its range. With mobile operation, where more audio output is usually required, the control is advanced into the second half of its range. Keeping the volume control at a low, but comfortable, level will reduce the "pumping" action that may occur on SSB signals.

1.3.2 Tuning Knob. The large knob directly below the dial window controls the actual frequency of operation after the desired band has been selected. A dual-speed reduction drive is incorporated to provide a slow tuning rate and, at the same time, to cover the entire band rapidly. In operation, the knob is turned to the desired portion of the frequency band and slightly past the desired frequency. When the knob rotation is reversed, the vernier action is increased by six for one complete revolution. Further rotation again engages the quick drive action.

1.3.3 Microphone Connector. The microphone jack is located at the lower center of the panel. The jack accepts a type PL-68 (small diameter) plug with the microphone connected to the sleeve and the push-to-talk switch connected to the tip. The SB-34 Transceiver is designed to operate with a medium or high-impedance dynamic microphone such as the Turner Model SR90D. Crystal or ceramic microphones will give poor results unless an auxiliary preamplifier is used, because of the very high impedance of the microphone and the low impedance transistor microphone amplifier. In addition, the rising characteristic of this type of microphone combined with the narrow bandpass of the mechanical filter employed in the SB-34 produces a somewhat unpleasant sound to the average voice. Carbon microphones will operate only if external provisions are made for supplying them with operating current.

1.3.4 Bandswitch. The bandswitching and exciter tuning functions are combined in a single knob located just below the meter. With the knob indication fully clockwise, the transceiver is set for 80 meters, and the front end of the receiver is peaked by rotating the knob through the arc labelled "80". Correct tuning is indicated by a sharp rise in background noise similar to that obtained with the "antenna tuning" control on a conventional receiver. To change to 40 meters, the knob is rotated counter-clockwise beyond the 80 meter arc. A click will be heard between the 80 and 40 meter arcs. This is the bandswitch changing to the 40 meter position. Tuning is again performed by rotating the knob within the 40 meter arc for a sharp rise in noise. This is progressively repeated for operation on the 20 and 15 meter bands.

A stop is provided at the extreme counter-clockwise end of rotation past the 15 meter arc. Do not attempt to move the knob past this stop. Damage may result, and the knob may slip and cause loss of calibration.

1.3.5 Pitch Control. The pitch control, located to the right of the volume control, provides a means for tuning the receiver frequency slightly to either side of the transmitting frequency. Thus, it is possible to set the pitch of the voice you are receiving to the most readable point without affecting your transmitting frequency.

1.3.6 Dial Correct. The dial correct knob, located to the right of the dial window, is used to adjust for any error in dial calibration. If an accurate calibration signal is not available, the correct knob should be left in the mid-position. An accessory 100 kc calibrator unit is available for accurately setting the dial. Alternately, the dial can be corrected on a signal of known accuracy. The use of other amateur signals for this purpose is, in general, not advisable.

1.3.7 USB/LSB Switch. This switch sets the transceiver to receive and transmit on either the upper sideband or the lower sideband. In general, it is common practice to use lower sideband on 80 and 40 meter band frequencies, and upper sideband on 20 and 15 meter frequencies. However, occasionally you will find exceptions. If the signal cannot be made intelligible by any amount of tuning, it is probably transmitting the sideband opposite to that which is selected on the USB/LSB switch. Changing the position of this switch does not disturb the dial calibration and no retuning is required.

1.3.8 CAL Switch. This switch controls the 100 kc calibrator accessory unit. Moving the switch up to the ON position inserts a beat signal every 100 kc on all bands.

1.3.9 XMTR Switch. With this switch in the lower position, the transmitter tube heaters and the high-voltage supply are turned off when the transceiver is operating mobile. This reduces battery drain to 0.6 amps and thus permits long periods of listening without fear of excessive battery drain. Operating the switch to the ON position actuates the high-voltage supply and the tube heaters. An audible hum from the built-in DC power supply transformer will be evident with the switch in the ON position; however, the hum level is low and will not interfere with the reception of a signal in the normal mobile environment. After a 30-second warm-up period, the transmitter is ready for operation. The XMTR switch operates only when the set is powered from a 12-volt DC battery; it does not function with 117-volt AC operation. With 117 volts AC, the heaters and high voltage supply are energized at all times.

1.3.10 PA TUNE. The PA TUNE control is intended primarily for loading the transmitter to the antenna. However, for maximum receiver sensitivity, it must be set to the point which is correct for transmitting. If the transmitter section is not being operated, adjust the PA TUNE control for maximum receiver volume with the PA LOAD capacitor set at one turn back from maximum clockwise position.

1.4 TRANSMITTER TUNEUP

NOTE

> Improper transmitter tuning can result in serious distortion and possibly operation outside the band. Improper adjustment of the MIC GAIN control can cause "flat-topping" and the generation of splatter and other spurious emissions. Make certain you understand the following instructions thoroughly before attempting to operate the transmitter.

Transmitter tuneup consists of adjusting the exciter, loading the power amplifier to the antenna, and setting the microphone gain control for optimum power output without distortion.

<u>1.4.1 Power Amplifier and Driver Tuning</u>. With the transceiver turned on, allow 30 seconds for warm-up of the transmitter tubes. Make certain a suitable 52 ohm dummy load is connected. Set the controls as follows:

1. TUNE-OPER -- To OPER
2. DIAL CORRECT -- Center of range
3. PITCH -- Off
4. METER -- Ip (in this function meter indicates PA plate current x 100 ma (0-500 ma).
5. BAND SELECTOR -- To desired band.
6. TUNING KNOB -- To desired frequency.
7. PA TUNE -- Full counter-clockwise (max. capacity).
8. PA LOAD -- Full counter-clockwise (max. capacity).
9. MIC GAIN -- Full counter-clockwise (min. gain).

<u>1.4.1.1</u> Adjust the bandselector knob within the arc of the band selected for maximum receiver noise.

<u>1.4.1.2</u> Set the TUNE-OPER switch to the TUNE position. The receiver will "quiet" and the meter will indicate PA plate current.

<u>1.4.1.3</u> Carefully re-adjust the band selector knob for maximum meter indication. This will occur at a setting very close to that which produced maximum receiver noise. One or more peaks may be evident if the band selector knob is tuned through the entire arc, but the correct setting will always be near the point of maximum receiver noise, and will always produce a much higher meter reading.

<u>1.4.1.4</u> Turn the PA TUNE control clockwise until a sharp dip in meter indication occurs.

<u>1.4.1.5</u> Set meter switch to ANT. In this function, the meter measures voltage across the load and the amplitude of the readings will be dependent on the actual load impedance. The meter, therefore, should be used only as an indicator of optimum transmitter tuning into the particular load.

<u>1.4.1.6</u> Turn the PA LOAD control clockwise for maximum (peak) meter reading. <u>NOTE:</u> The PA LOAD control is a mica compression trimmer. This control rotates at least four full turns to go from minimum to maximum capacity.

1.4.1.7 Re-adjust PA TUNE control for maximum (peak) meter reading.

1.4.1.8 Repeat steps 1.4.1.6 and 1.4.1.7 until the meter reads maximum possible, with final adjustment being the PA TUNE control.

1.4.1.9 Return the tune-oper. switch to the oper. position.

1.4.1.10 Connect microphone or two tone signal and key the transmitter. The ANT reading should be zero with no modulation or with mic gain fully CCW and the reading should be approximately the same as was obtained in the TUNE mode when heavy modulation is applied with mic gain fully clockwise.

2. THEORY OF OPERATION

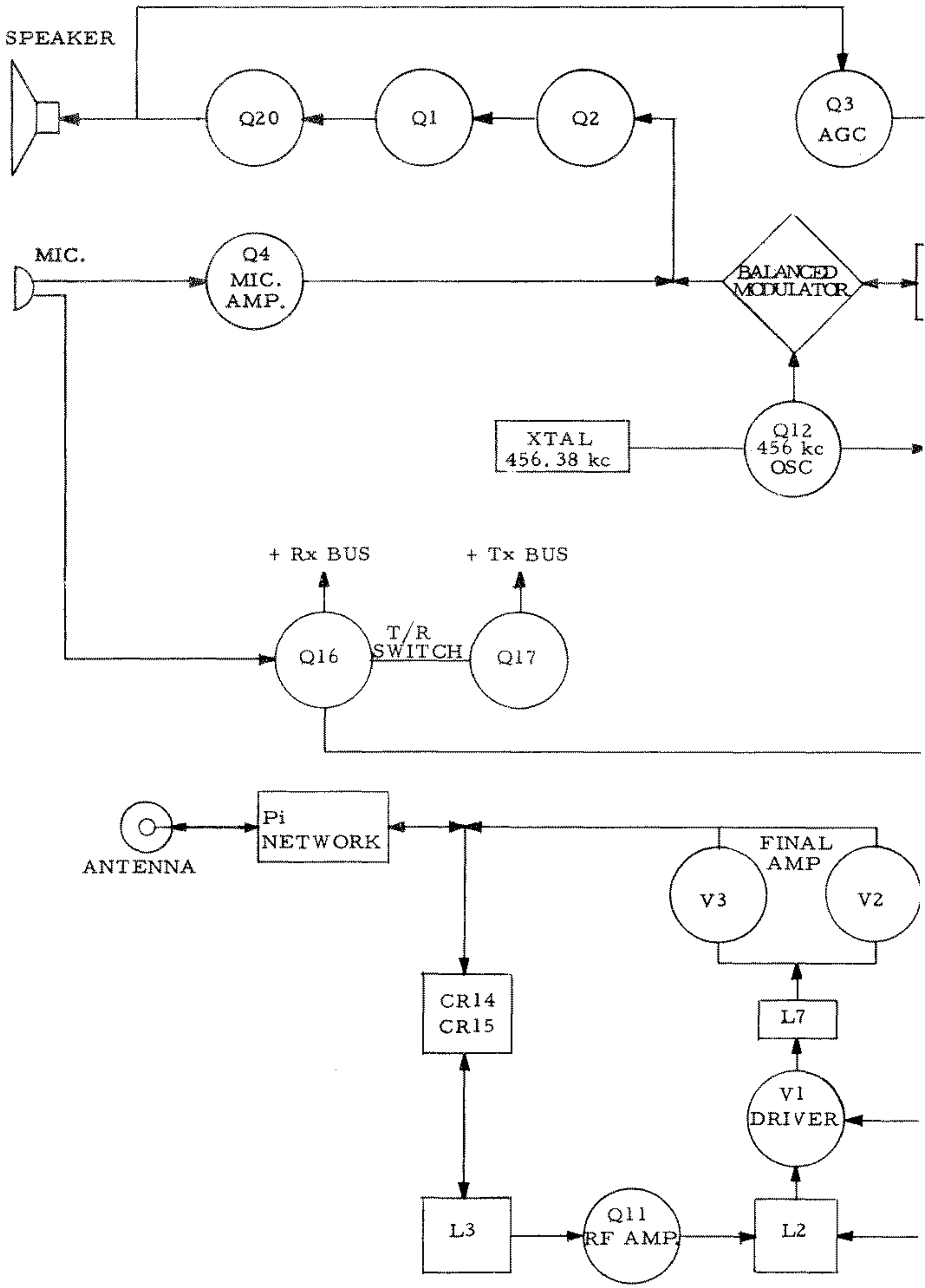
BASIC TRANSCEIVER OPERATION

2.1.0 (Refer to Block Diagram). In the transmit mode, an audio signal from the microphone is amplified by microphone amplifier Q-4 and applied to the balanced modulator. The double sideband suppressed carrier output of the balanced modulator is impressed across T-2 and amplified by Q-5. Q-6 is biased off in transmit and therefore does not interfere with the amplifier operation. The mechanical filter, upon receiving the amplified double sideband signal from Q-5, passes the lower sideband frequency (456.38 minus the modulating frequency) and suppresses the upper sideband frequency (456.38 plus the modulating frequency). In the USB mode, the signal appearing at the output of the filter is subtractively mixed at CR-9 with an injection of 2738.28 kc from T-5 to produce a resultant frequency of 2281.9 kc plus the modulating frequency. In the LSB mode, the filter output is additively mixed at CR-9 with an injection of 1825.25 kc from T-5 to produce a resultant frequency of 2281.9 kc minus the modulating frequency.

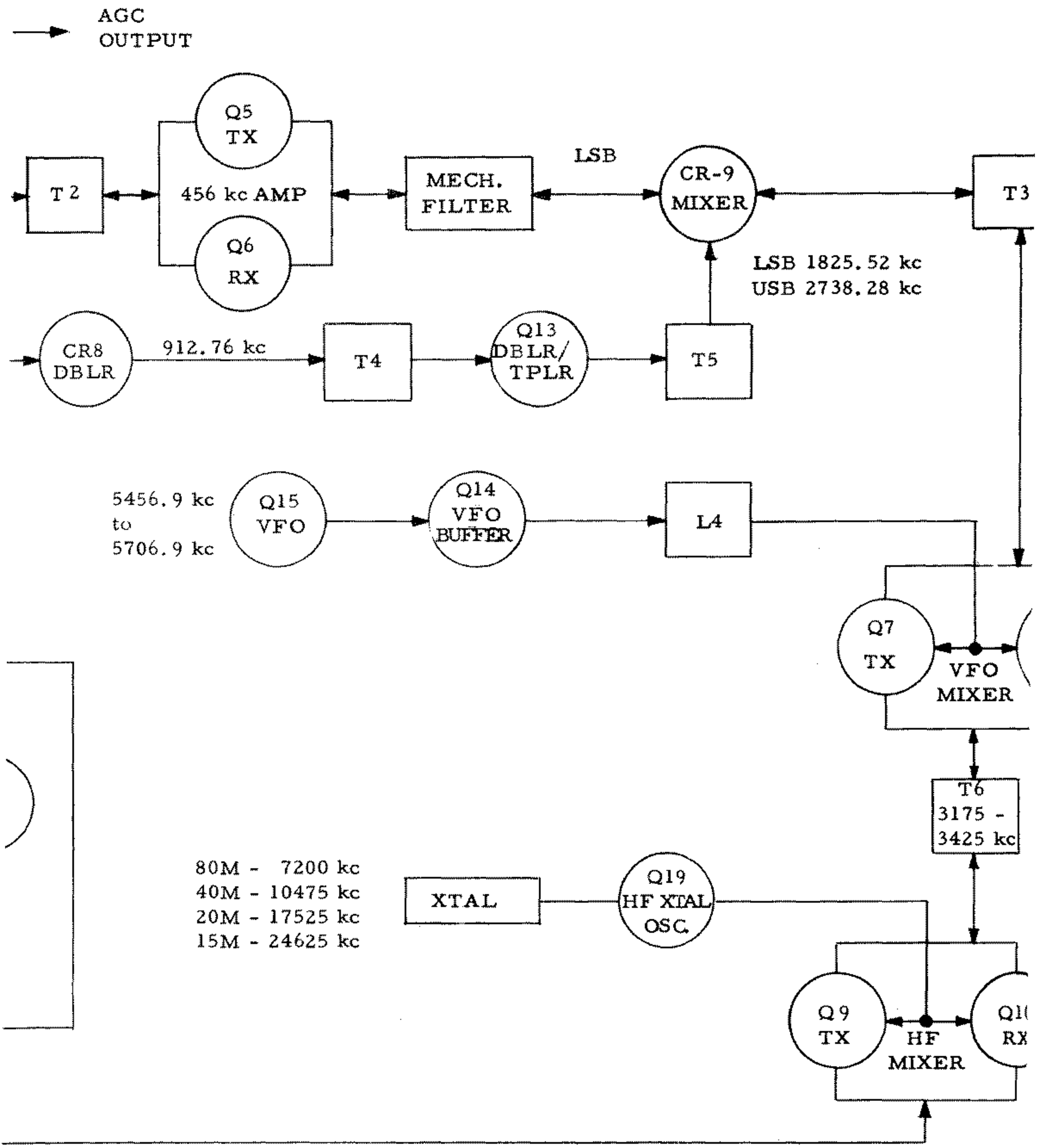
The 2281.9 kc upper or lower sideband output from T-3 is applied to the VFO transmit mixer Q-7. Q-8 is cut off as it is not being used. Also applied to Q-7 is the VFO oscillator injection, tunable from 5456.9 kc to 5706.9 kc. The injection serves to translate the incoming signal to a range variable from 3175 kc to 3425 kc. This range of frequencies is then passed to the high frequency mixer Q-9, which converts the signal, by means of appropriate oscillator injection, to the final operating frequency. The signal is then applied to the grid of V-1 driver which, in turn, drives the final power amplifiers. The power amplifier output is then matched to the transmission line and antenna by means of the pi network.

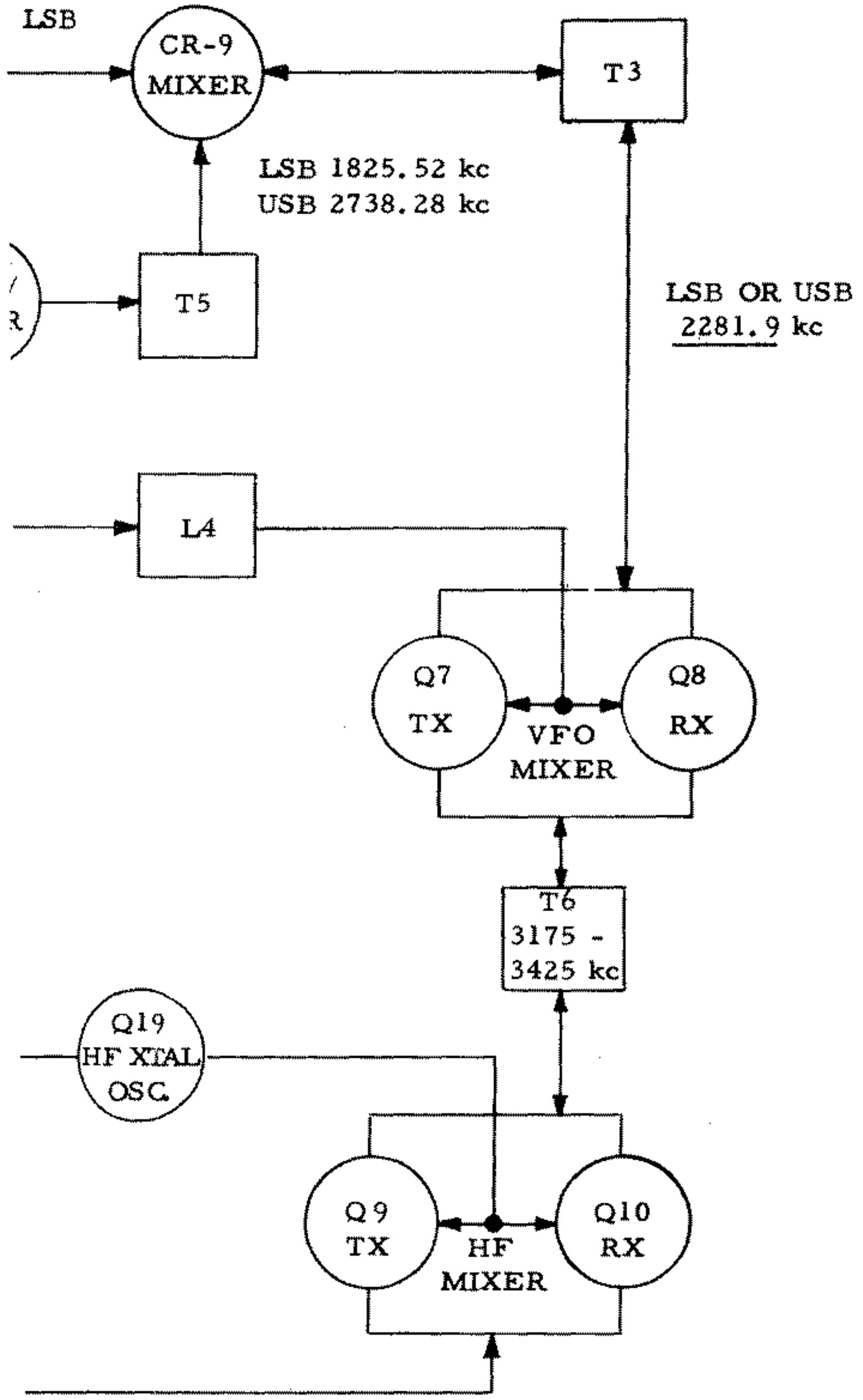
2.1.1 Receive Function. With the microphone button released, a signal from the antenna is loosely coupled from the transmitter pi-section net to the top of L-3. Diodes CR-14 and CR-15, across L-3 conduct only when extremely strong signals are present and do not otherwise affect the circuit. The signal at L-3 is coupled to the emitter of Q-11 which operates as a common-base amplifier. The amplified signal from Q-11 is applied to high-frequency mixer Q-10 through L-2. With injection from Q-19, this stage converts the signal to a frequency within the range 3175-3425 kc. The converted signal is then mixed by Q-8 to 2281.9 kc with injection from the VFO Q-14 and Q-15. The converted signal is finally mixed by diode CR-9 to the 456.38 reference frequency in a manner exactly opposite to that described for this stage during the transmit function. Output from the filter is then amplified by Q-6 and coupled through T-2 to the balanced modulator CR-4/CR-7.

With injection from the carrier oscillator, the balanced modulator now functions as a detector, and produces an audio output which is applied to the base of Q-2. Output is taken from the collector and coupled to audio driver Q-1. This stage, in turn, drives the audio power amplifier Q-20 which increases the signal to speaker level.



SPEAKER
Q20
Q1
Q2
Q3
AGC
MIC.
Q4
MIC.
AMP.
BALANCED
MODULATOR
XTAL
456.38 kc
Q12
456 kc
OSC
+ Rx BUS
+ Tx BUS
Q16
T/R
SWITCH
Q17
ANTENNA
Pi
NETWORK
FINAL
AMP
V3
V2
CR14
CR15
L7
V1
DRIVER
L3
Q11
RF AMP.
L2

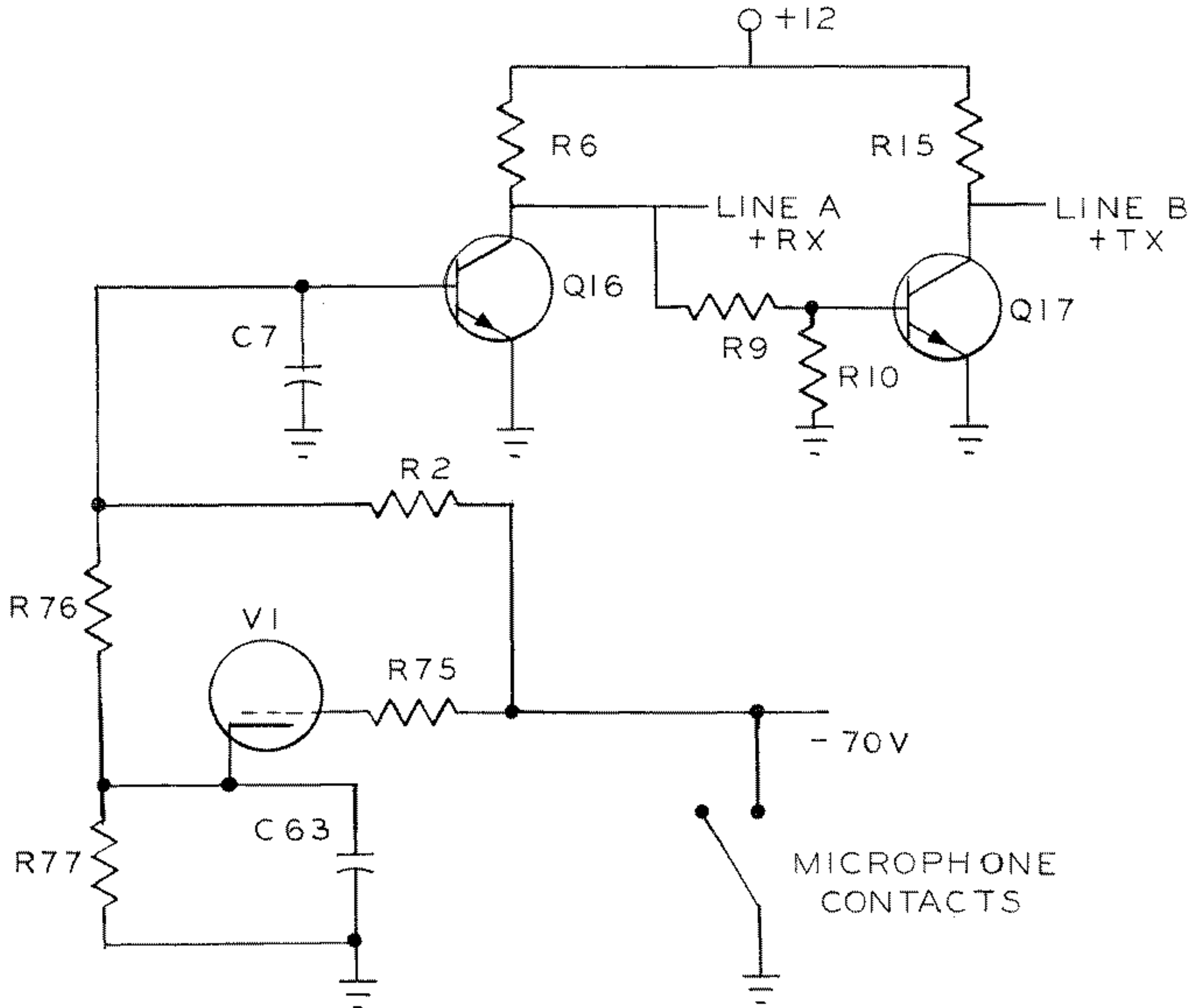

AGC
OUTPUT
Q5
TX
T 2
456 kc AMP
Q6
RX
MECH.
FILTER
LSB
CR-9
MIXER
T3
LSB 1825.52 kc
USB 2738.28 kc
CR8
DBLR
912.76 kc
T4
Q13
DBLR/
TPLR
T5
5456.9 kc
to
5706.9 kc
Q15
VFO
Q14
VFO
BUFFER
L4
Q7
TX
VFO
MIXER
T6
3175 -
3425 kc
80M - 7200 kc
40M - 10475 kc
20M - 17525 kc
15M - 24625 kc
XTAL
Q19
HF XTAL
OSC.
Q9
TX
HF
MIXER



SB-34 BLOCK DIAGRAM

2.2 Keying Circuit. The operation of the Electronic Keying Circuit used in the SB-34 may be understood by referring to the following diagram.

2.2.1 Keying Circuit



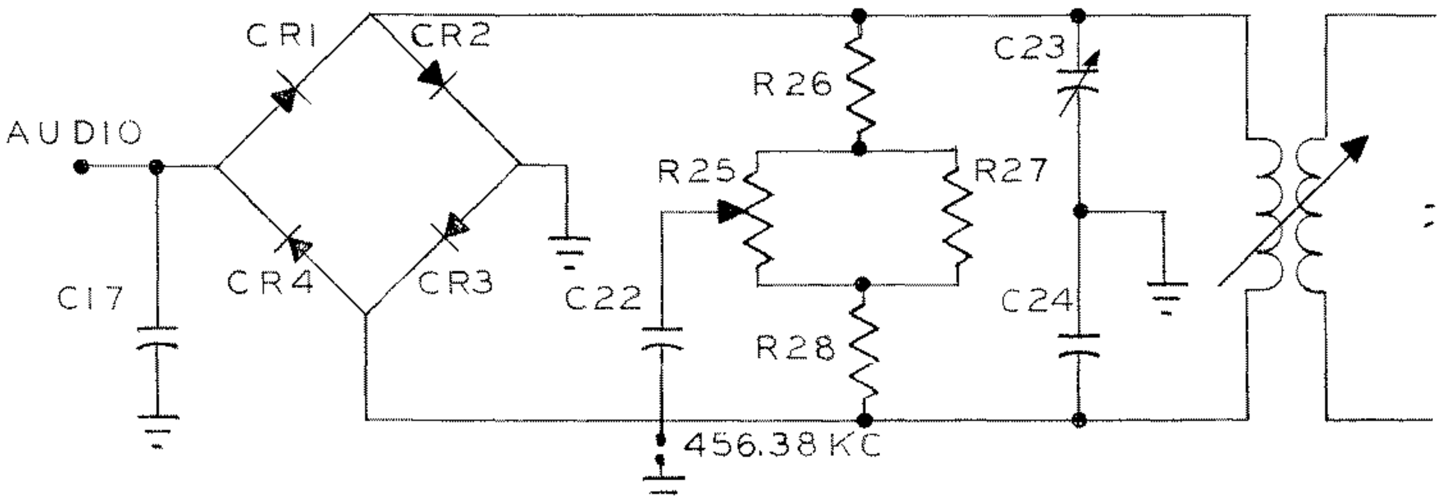
The base of Q-16 is coupled through a current limiting resistor to the cathode of V-1. In the receive mode, V-1 is cut off and the cathode is at ground potential. This causes Q-16 to be reverse - biased and no current flows through the transistor. With Q-16 cut off, its collector potential is +12 volts. This positive voltage is supplied to control line A and also to the base of Q-17 causing Q-17 to conduct to saturation. Under this condition, the collector and control line B are at ground potential and the voltage requirements of the receive circuits are satisfied.

In the transmit mode, with the microphone button pressed, the bias on V-1 is removed and the tube conducts. The cathode potential rises to +6 volts and with this voltage applied to the base, Q-16 conducts to saturation. Control line A and the base of Q-17 are now at ground potential and the collector of Q-17 is +12 volts.

2.3 Balanced Modulator. The function of the balanced modulator is to mix a carrier frequency with audio input signals and to suppress the injected carrier to the point where it does not appear in the output signal.

The balanced modulator produces two output frequencies equal to the carrier frequency plus the modulating frequency and the carrier frequency minus the modulating frequency. The carrier is suppressed by amplitude and phase cancellation.

2.3.1 Balanced Modulator



With no modulation applied to the bridge, no signal appears across T-2. The 456.38 kc signal from oscillator Q-12 is injected into the bridge through C-22 blocking capacitor to the center arm of R-25. Injection voltage is 1 to 1.5 volts rms for proper operation. The common point of CR-2 and CR-3 is grounded directly. The common point of CR-1 and CR-4 is grounded at the carrier frequency by C-17. On positive half cycles of carrier, CR-2 and CR-4 conduct and current flows through them in a loop which includes the resistive arm across the ring and its common ground return. Assuming CR-2 and CR-4 have forward resistance, a small voltage would appear at both sides of the primary of T-2. These voltages are matched in amplitude by R-25 and in phase by C-23, so that when they arrive at T-2 they are cancelled.

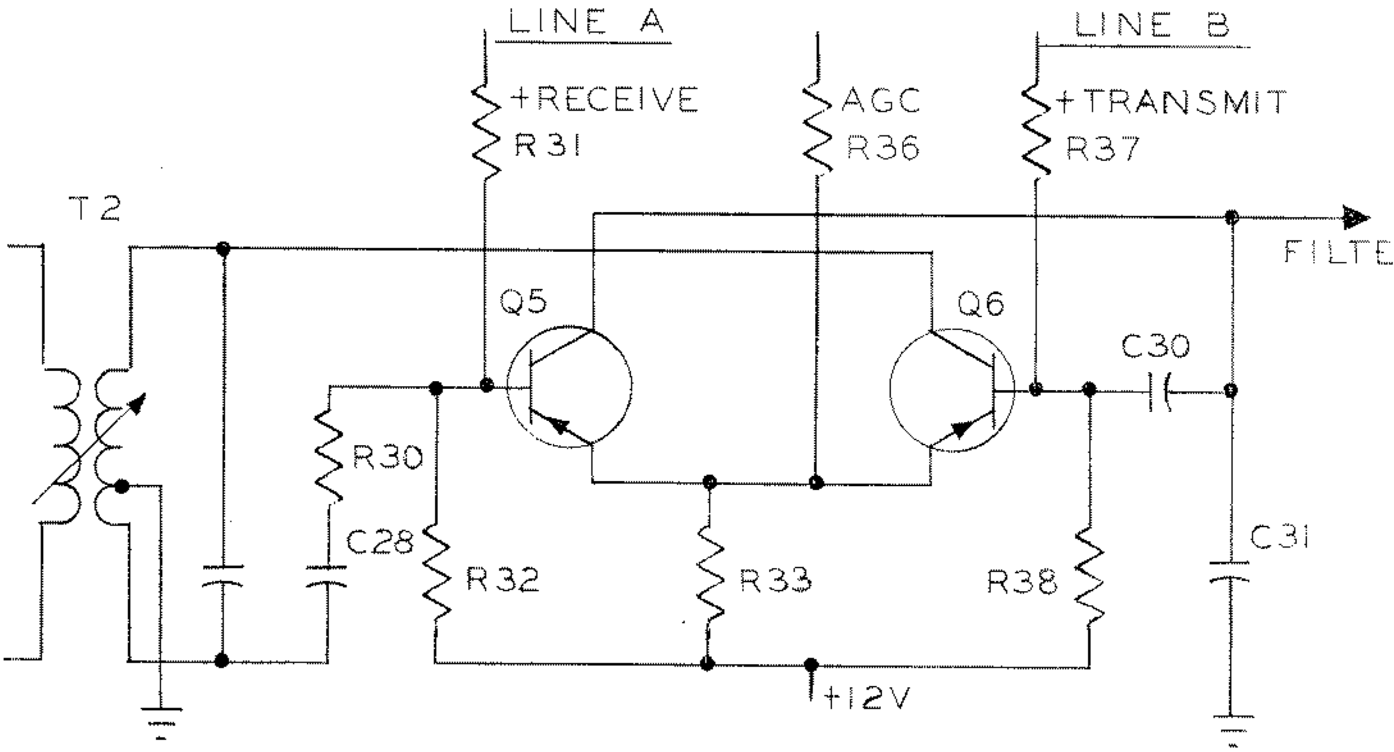
On the negative half-cycle, CR-1 and CR-3 conduct while the other diodes are turned off. Cancellation of residual carrier takes place as before.

When an audio signal (controlled by the microphone gain pot and amplified by Q-4) is applied to the modulator, it unbalances the circuit by biasing the diodes in one path, depending on the instantaneous polarity of the audio, and some R-F will appear at the output. The R-F appearing at T-2 will be a double sideband, suppressed carrier signal.

In the receive mode, the process is reversed and the balanced modulator functic as an audio detector.

2.4 Theory of Operation-Bilateral Circuit-456 kc Amp. The operation of a typical bilateral stage may be understood by referring to the following diagram.

2.4.1 456 kc Amp



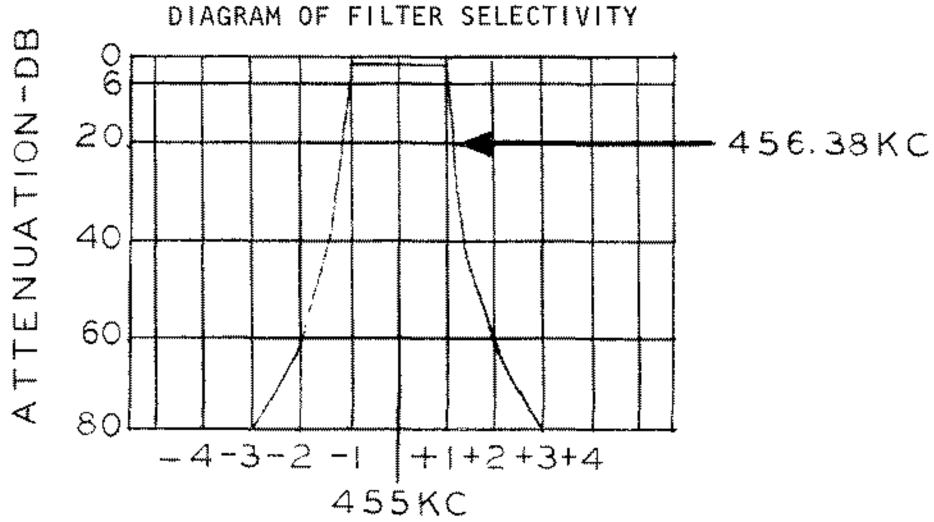
In the receive mode, the base bias resistor of Q-5 is returned to line A (+receive) which carries a +12v potential. Under this condition, Q-5 is reversed-biased and cannot conduct. The base bias resistor of Q-6, however, is returned to line B (+transmit) which is essentially ground potential and Q-6 is in conduction and able to amplify. Thus, a signal appearing at the mechanical filter will be amplified and delivered to T-2.

In the transmit mode, witn the microphone button pressed, control line B is positive and line A is near ground. Q-6 is cut off and Q-5 is in conduction. Under this condition, a signal appearing at T-2 will be amplified and delivered to the mechanical filter.

In the SB-34, bilateral circuit configurations are also used in the VFO mixer (Q-7 and Q-8), and the high frequency mixer (Q-9 and Q-10). The same tuned circuits are used for both transmitting and receiving and the various injection oscillators operate continuously supplying local oscillator signal to the proper mixer stages.

2.5 Mechanical Filter. The purpose of the mechanical filter is to suppress the unwanted upper sideband generated in the balanced modulator. This is accomplished by placing the passband of the filter to one side of the center frequency of the 456 kc amp. Refer to the following diagram.

DIAGRAM OF FILTER SELECTIVITY



Notice that the frequency which is used as the reference (456.38 kc) and all frequencies above, appear outside the passband of the filter. The only frequencies that are passed without attenuation, are those which appear between the 6 db points on the curve.

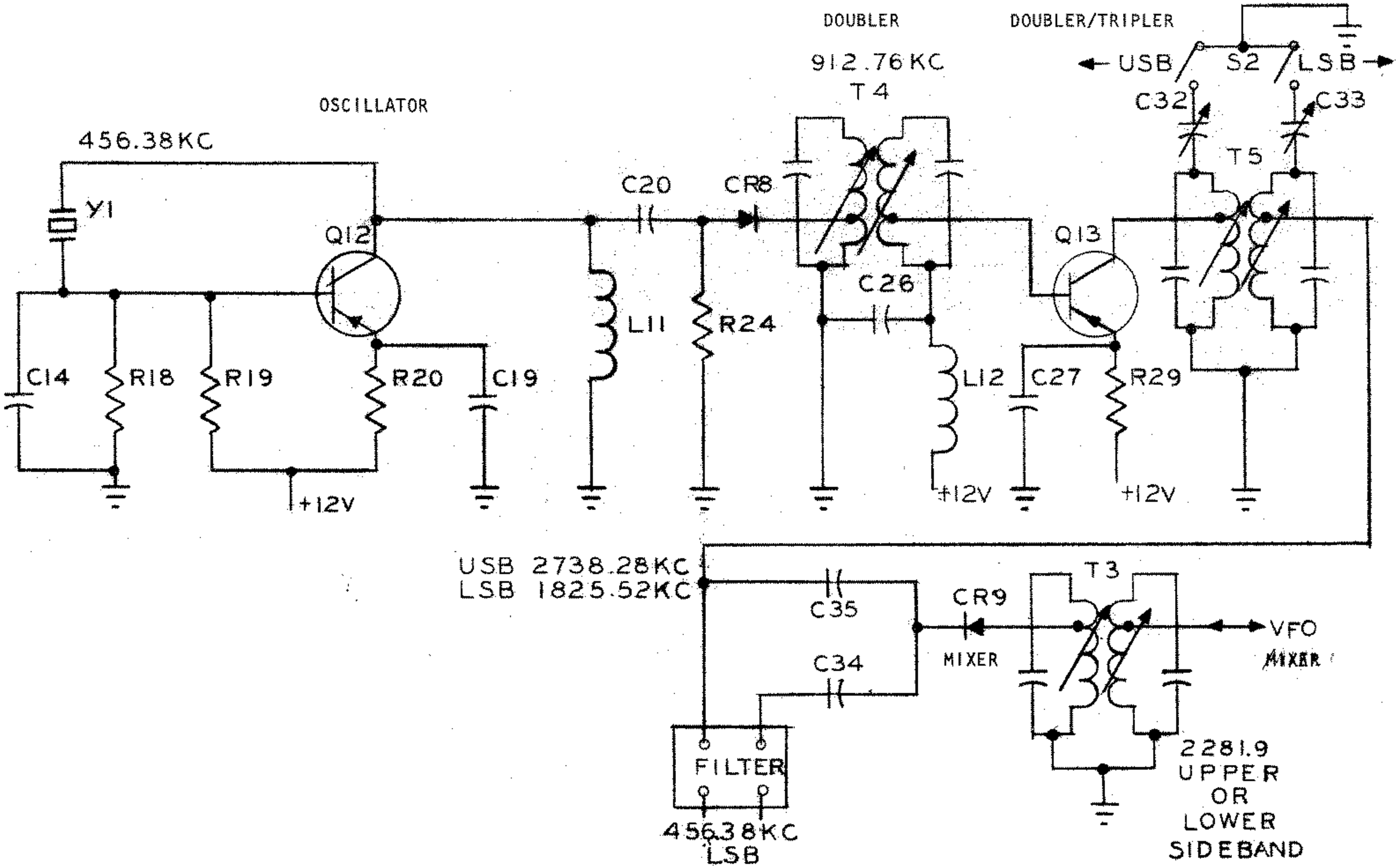
Example: If the modulating frequency is a 1 kc tone, the output from the balanced modulator will contain the upper and lower sideband frequencies - 455.38 kc and 457.38 kc. These frequencies are amplified by the 456 kc amp and passed to the mechanical filter. The filter will pass the lower sideband (455.38) and reject the upper sideband (457.38).

The filter always passes the lower sideband only and is unaffected by the position of the upper/lower switch.

2.6 Sideband Selection. (Refer to the following diagram)
Q-12 is a crystal controlled oscillator operating at 456.38 kc. Its output is used for R-F injection to the balanced modulator and for sideband selection. The signal is coupled through C-20 to doubler diode CR-8. Transformer T-4 is tuned to twice the input frequency (2 x 456.38 = 912.76 kc). The output of T-4 is then inductively coupled to the base of Q-13 where the signal is then either doubled or tripled depending on the position of the USB/LSB switch S-2. With S-2 in the USB position, T-5 is resonant to 2738.2 kc, thus the 912.76 kc applied to this stage will be tripled. With S-2 in the LSB position, C-32 and C-33 are added to the tank lowering the resonant frequency to 1825.5 kc, thus doubling the input frequency.

Doubler/tripler transformer T-5 is connected in a ring with the mechanical filter, mixer CR-9 and transformer T-3 which is tuned to 2281.9 kc. In transmit with the mode selector in LSB, the output from T-5 is additively mixed with the lower sideband output from the mechanical filter to produce a lower sideband signal at 2281.9 kc. When the mode selector is in USB, the output from T-5 is subtractively mixed with the lower sideband output from the filter to generate an upper sideband signal still at 2281.9 kc. Thus the mode selector, by adjusting T-5 to either double or triple, determines the mode of the sideband signal.

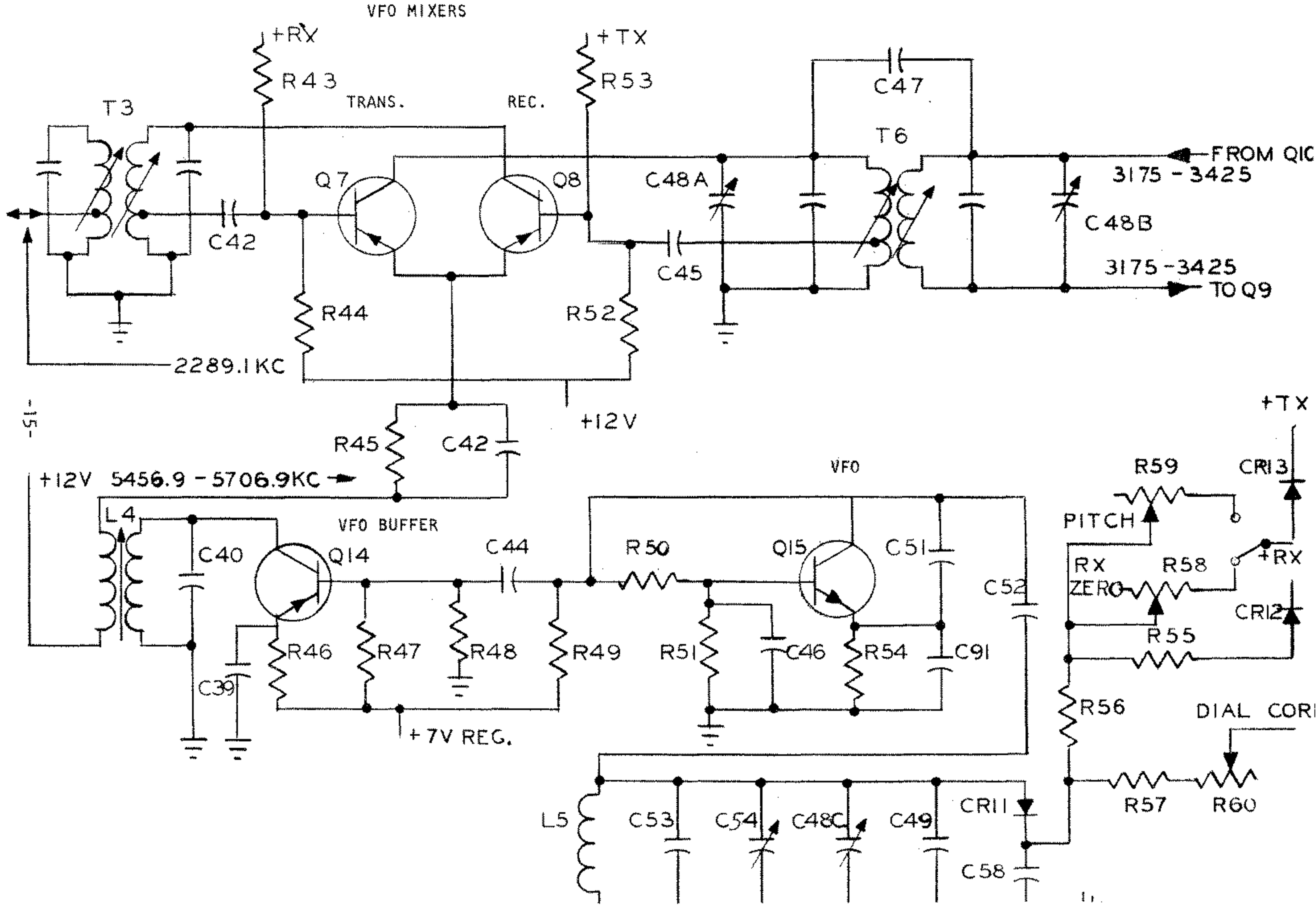
In the receive mode, the preceeding frequency translation process is reversed.


OSCILLATOR
456.38KC
Y1
Q12
C14
R18
R19
R20
C19
+12V
C20
CR8
L11
R24
DOUBLER
912.76KC
T4
C26
L12
+12V
DOUBLER/TRIPLER
USB
S2
LSB
C32
C33
T5
Q13
C27
R29
+12V
USB 2738.28KC
LSB 1825.52KC
C35
C34
CR9
MIXER
T3
VFO
MIXER
FILTER
456.38KC
LSB
2281.9
UPPER
OR
LOWER
SIDEBAND

2.7 VFO Oscillator and Mixer. (Refer to the following diagram)
The variable frequency oscillator operates over a range of 5456.9 kc to 5706.9 kc. The oscillator is basically of colpitts design and is supplied with a continuously regulated voltage in order to maintain stability during line voltage changes. CR-11 varactor diode maintains a constant parallel capacitance across the tank when the voltage applied to the diode remains constant; thereby providing frequency stability by means of voltage control. Voltage differences between transmit and receive are compensated by R-58 receiver zero adjust pot. R-58 effectively compensates for variation between CR-12 and CR-13. When these diodes are balanced, the voltage appearing at the varactor diode will be the same in transmit or receive and the frequency of the VFO will remain the same. When the pitch switch is turned on, R-59 pitch control replaces the receiver zero adjust thereby allowing the operator to change the receive frequency in relation to the transmitter frequency. Drift resulting from temperature variation is minimized by temperature compensating capacitor C-49. The output is coupled through C-44 to buffer Q-14 and then to the emitter of VFO mixers Q-7 and Q-8 through L-4.

In the transmit mode, Q-7 is operating and combines the 2281.9 upper or lower sideband signal from T-3 with the variable 5456.9 to 5706.9 kc output from the VFO resulting in an output signal variable from 3175 kc to 3425 kc. Transformer T-6 is gang tuned with the VFO and thus is always tuned to the desired frequency.

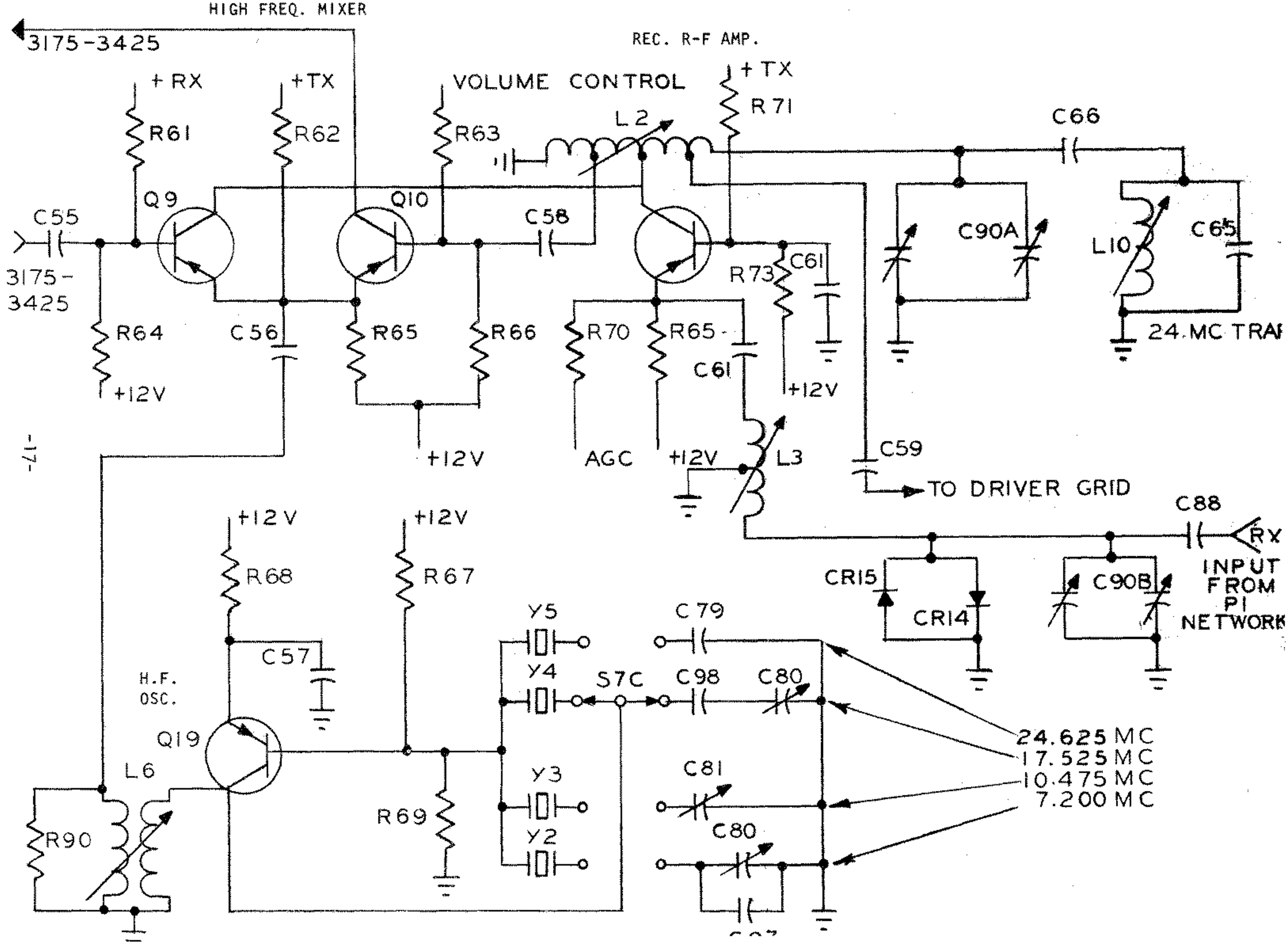
In the receive mode, Q-8 is operating and the preceeding process is reversed, resulting in an output frequency of 2281.9 upper or lower sideband being delivered to T-3.


VFO MIXERS
+RX
R43
TRANS.
REC.
+TX
R53
C47
T3
T6
FROM Q1C
3175 - 3425
Q7
Q8
C48A
C48B
C42
C45
3175-3425
TO Q9
R44
R52
2289.1KC
+12V
R45
C42
+12V 5456.9 - 5706.9KC
VFO
R59
CR13
PITCH
+TX
L4
VFO BUFFER
C40
Q14
C44
R50
Q15
C51
RX
R58
+RX
ZERO
C52
CR12
R55
R46
R47
R48
R49
R51
C46
R54
C91
C39
+7V REG.
R56
DIAL CORR
L5
C53
C54
C48C
C49
CR11
R57
R60
C58

2.8 High Frequency Oscillator, Mixer and Receiver R-F Amplifier. (Refer to Following Diagram)

In transmit, the 3175 to 3425 kc sideband signal from Q-7 is applied to high frequency mixer Q-9. Also applied to this mixer is an injection from high frequency crystal oscillator Q-19. The frequency generated by this oscillator may be 7200, 10475, 17525 or 24625 kc depending upon the position of the bandswitch. Here again, the 3175-3425 kc incoming signal is subtractively mixed to produce the final output frequency. Output from mixer Q-9 appears across tuner coil L-2. The resonant frequency of L-2 is controlled by a large variable capacitor and special slug which penetrates into the coil by an amount depending upon the setting of the bandswitch. The large variable capacitor is mechanically linked to the bandswitch through a Geneva movement so that rotating the capacitor shaft tunes the coil through a limited range bracketing the selected operating band. Changing the bandswitch to the next band tunes a limited range bracketing this band, etc. On 80 meters, the slug is almost fully penetrated into the coil and the capacitor is near maximum capacity. On 40 and 20 meters, the slug and capacitor are near mid-range, and on 15 meters the slug is fully withdrawn and the capacitor is near minimum. By this unique method of tuning the bandswitching, the Q and inductance/capacitance ratio of L-2 and the variable capacitor are near optimum on all bands, and the resonant impedance remains essentially constant across the entire tuning range. This tuning is ganged with, and duplicated in, antenna coil L-3 and driver coil L-7 which results in exciter train tuning with only one control.

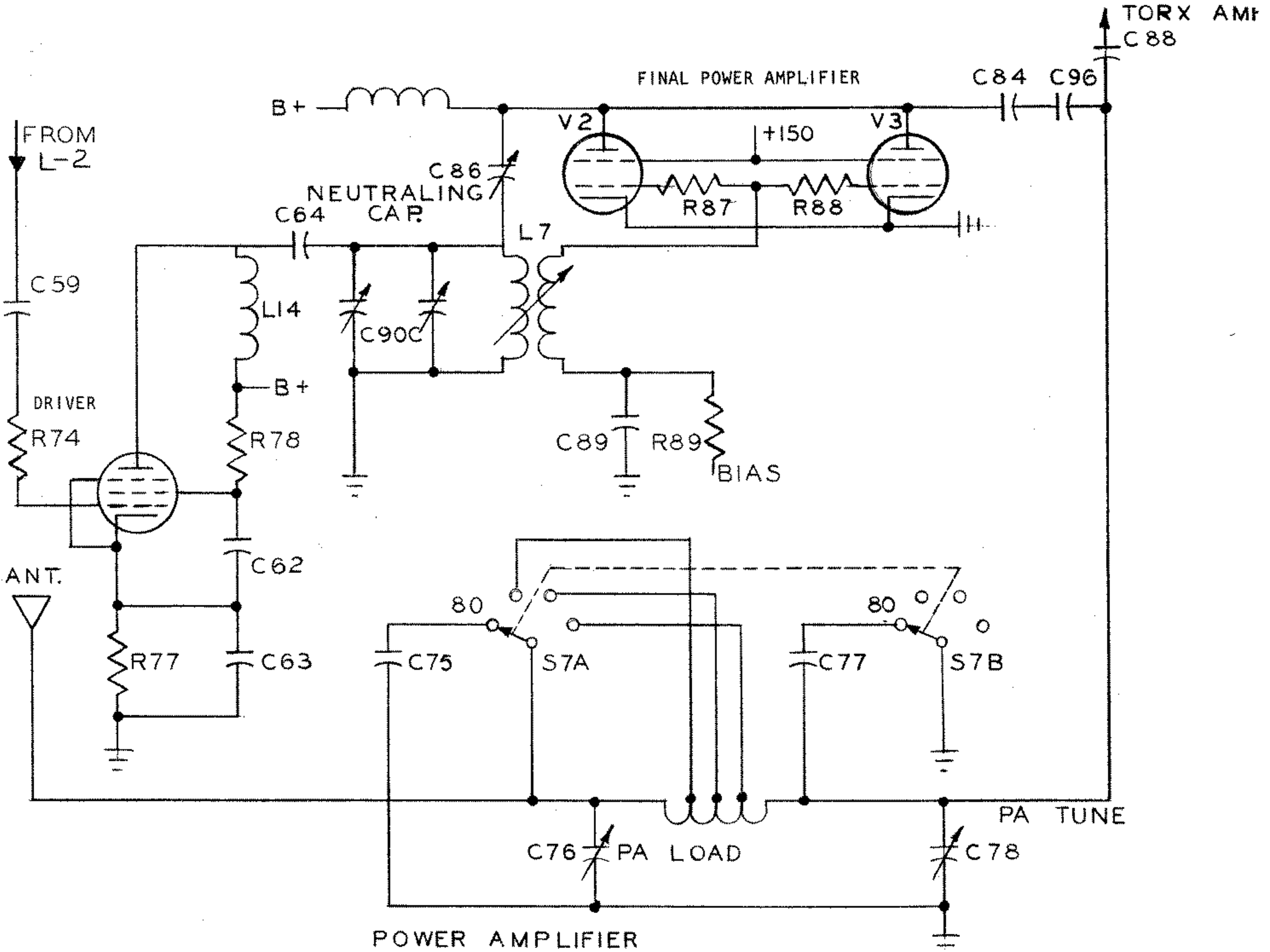
With the microphone button released, a signal from the antenna is loosely coupled from the transmitter pi-section net to the top of L-3. Diodes CR-14 and CR-15 across L-3 conduct only when extremely strong signals are present and do not otherwise affect the circuit. The signal at L-3 is coupled to the emitter of Q-11 which operates as a common-base amplifier. The amplified signal from Q-11 is applied to high-frequency mixer Q-10 through L-2. With injection from Q-19, this stage converts the signal to a frequency within the range 3175-3425 kc. This converted signal is then passed to T-6 and Q-8 VFO mixer.


HIGH FREQ. MIXER
3175-3425
REC. R-F AMP.
+RX
+TX
VOLUME CONTROL
L2
+TX
R71
R61
R62
R63
C66
Q9
Q10
C55
C58
C90A
L10
C65
3175-
3425
R73
C61
R64
C56
R65
R66
R70
R65
C61
24.MC TRAP
+12V
+12V
AGC
+12V
+12V
L3
C59
TO DRIVER GRID
C88
RX
INPUT
FROM
PI
NETWORK
+12V
+12V
CR15
C90B
R68
R67
CR14
Y5
C79
C57
Y4
S7C
C98
C80
H.F.
OSC.
Q19
24.625 MC
17.525 MC
10.475 MC
7.200 MC
L6
Y3
C81
R69
R90
Y2
C80

2.9 Power Amplifier Circuits. (Refer to the following diagram)
The single-sideband suppressed-carrier final output signal from L-2 is applied to the grid of transmitter driver V-1 where it is amplified, and appears across L-7. A low-impedance winding on L-7 couples the signal to the paralleled grids of power amplifier V-2 and V-3.

Neutralization of the power amplifier is accomplished by feeding back a small amount of output through C-86 to the top of L-7 with the low impedance winding providing the necessary phase reversal.

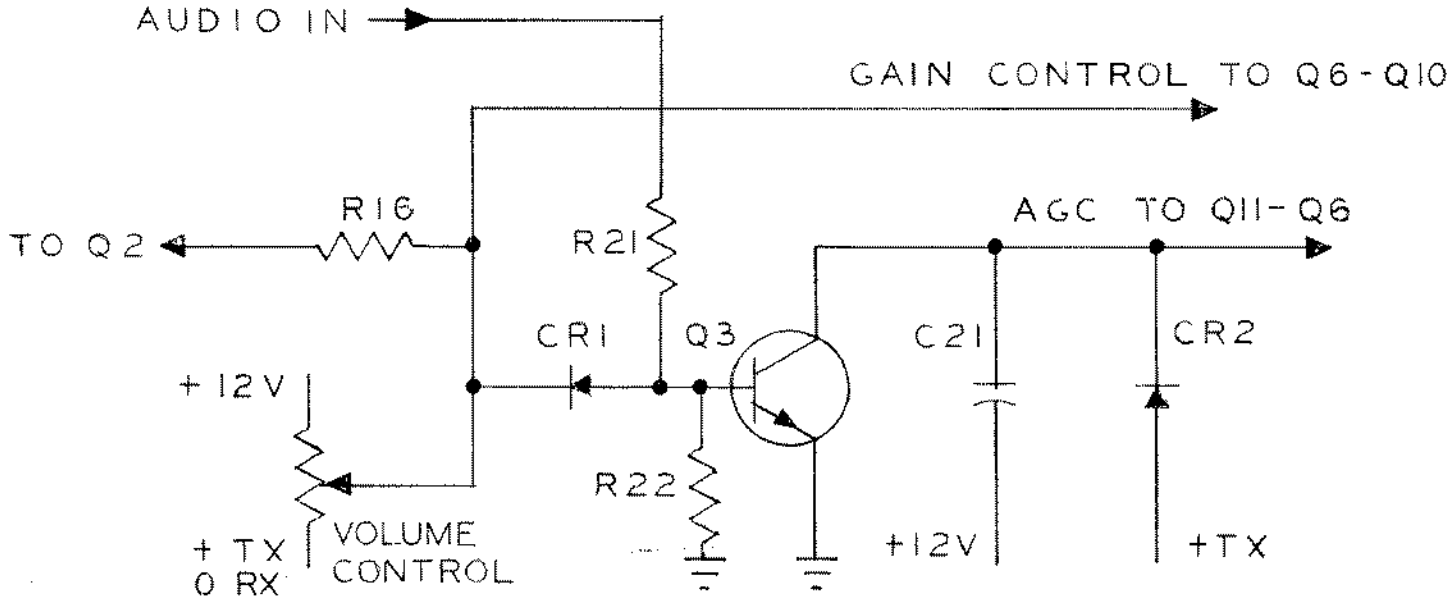
Final output from V-2 and V-3 is fed to a pi-section network consisting of L-9 and the PA TUNE and PA LOAD capacitors. A section of the bandswitch adjusts the inductance of L-9 to the correct value for each band, and also adds fixed amounts of capacity to both the PA LOAD and PA TUNE capacitors on 80 meters.



POWER AMPLIFIER

2.10 AGC Operation. The volume control sets the gain of the high-frequency mixer, the 456 kc amplifier and, to a small extent, the first audio amplifier, Q-2. Other signal stages operate at full gain except in the presence of AGC action.

2.10.1 AGC Circuit



RF amplifier Q-11 and I-F amplifier Q-6 are gain controlled by AGC amplifier Q-3. An audio signal appearing across the speaker terminal causes Q-3 to conduct heavily. The voltage at its collector is normally close to that of the supply, +12 volts. When Q-3 conducts, however, the collector potential falls rapidly and charges the 250 mfd capacitor (connected between collector and the 12 volts bus) to some value less than 12 volts. This AGC voltage is connected to the emitters of the R-F amplifier and the 456 kc amplifier. As the AGC voltage falls toward ground potential, the gain of these stages is reduced until the audio output is stabilized.

The AGC action is proportioned such that the R-F amplifier becomes largely cut off in the presence of even moderate signals so that following stages are protected from signal overload. If the signal fades, causing the audio output to drop, Q-3 conducts less and the 250 mfd capacitor slowly discharges towards the +12 volts potential, causing the stage gain to be restored as necessary to maintain the audio level.

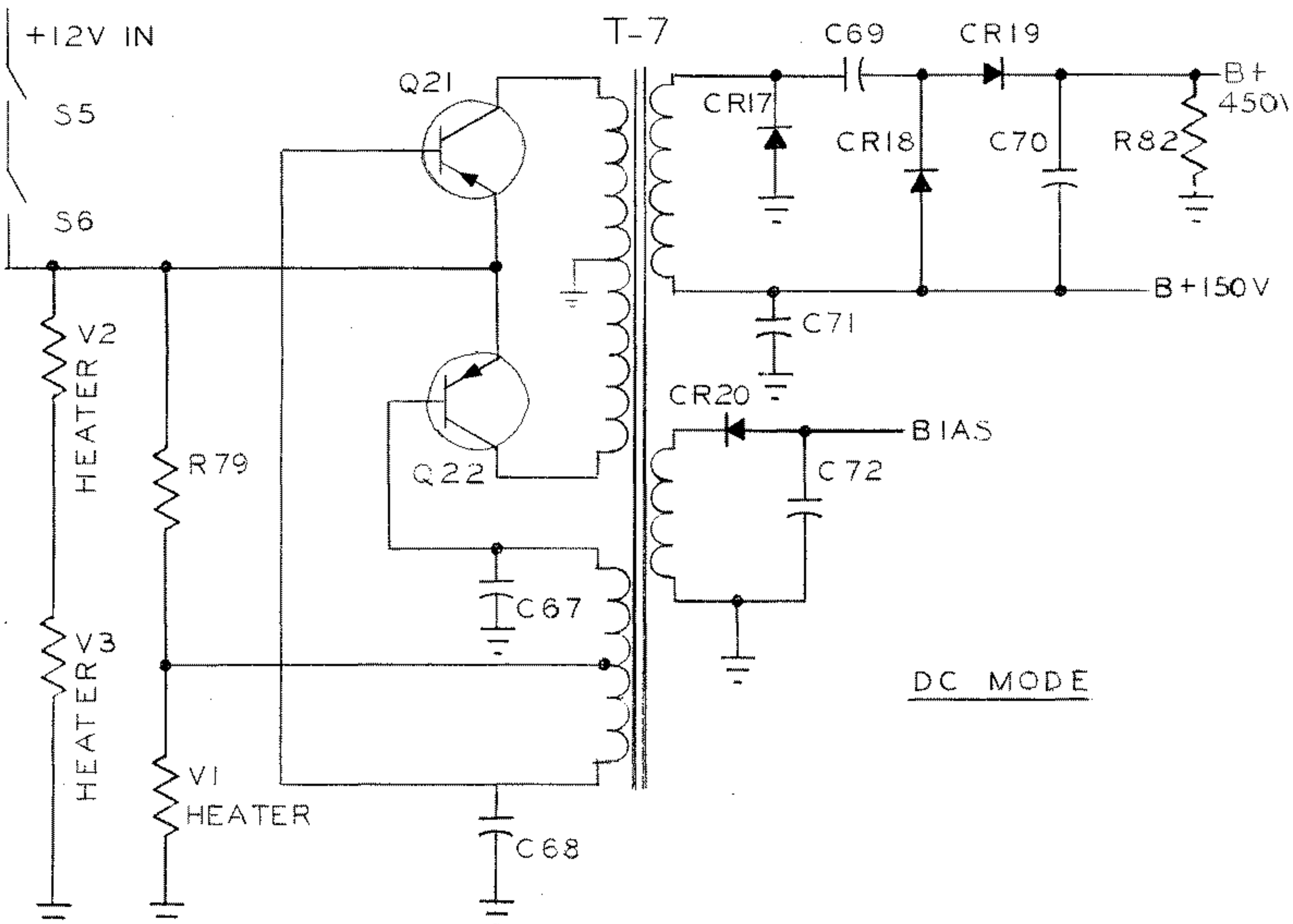
When the VOLUME control approaches the fully clockwise position, diode CR-1, connected to the base Q-3, begins to limit the amount of audio applied for AGC action. With this occuring, more audio output is produced for a given amount of AGC. Finally, with the volume control fully clockwise, the base of Q-3 is clamped off and full audio output is produced.

Diode CR-2, in the collector of Q-3, conducts when the unit is switched to transmit. This conduction charges the 250 mfd capacitor to the 12 volt potential so that when the set is switched back to receive, full receiver gain is instantly available.

2.11 Power Supply DC Operation. (Refer to diagram below)

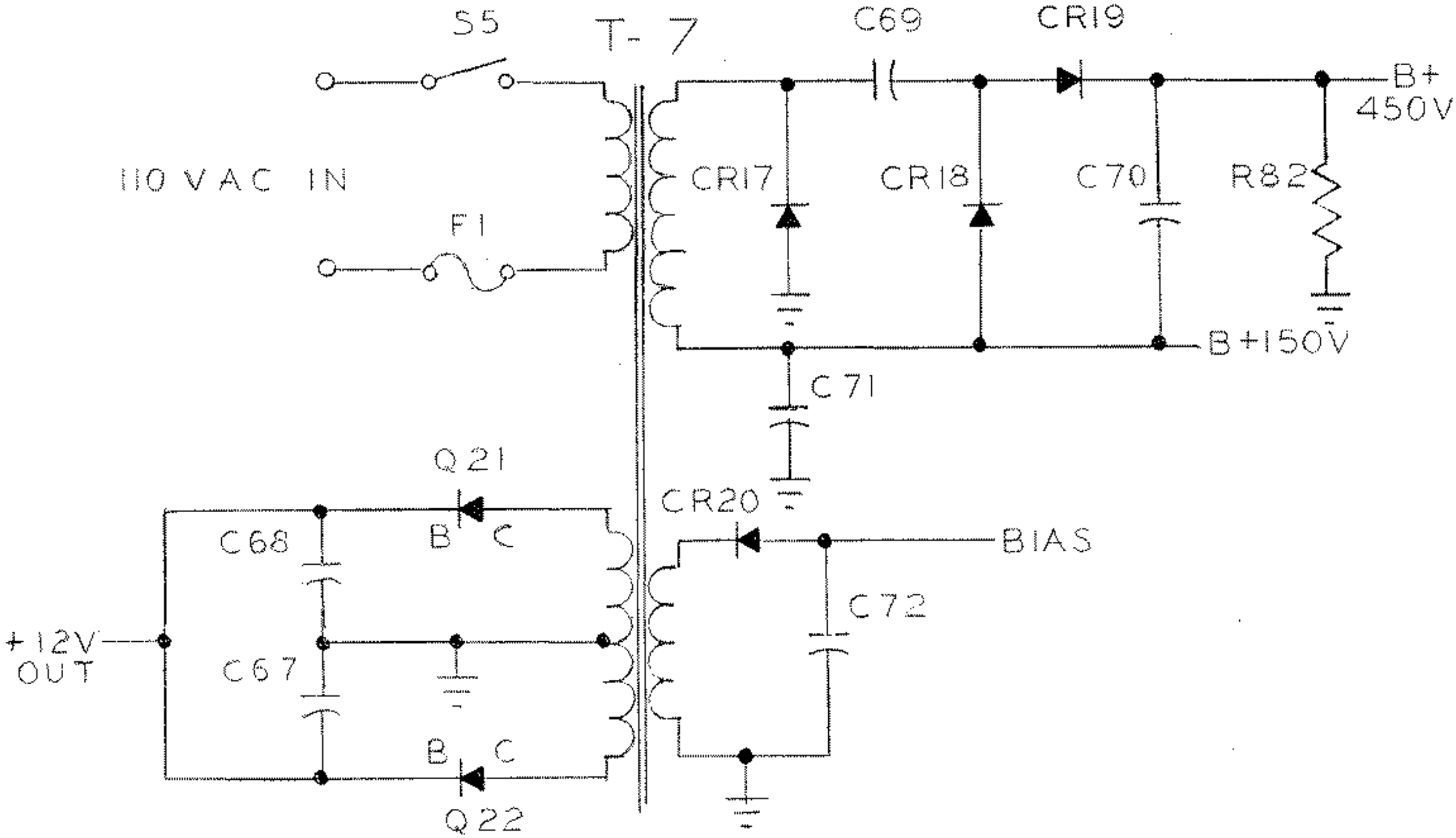
The SB-34 contains a power supply designed to operate from either 117 volts AC or 12 volts DC (negative ground). Inserting the appropriate power cord into the rear-panel receptacle makes the necessary connections to operate the supply in either mode.

With DC operation, transistor Q-21 and Q-22 are connected as a common-emitter power oscillator. Starting bias for this oscillator is obtained from a small resistor and the heater current of driver tube V-1. All of the transmitter-tube heaters and input voltage to the oscillator are applied through the XMTR switch so that the receiver portion of the transceiver may be operated with reduced power consumption. A high-voltage winding of T-7 is connected to a voltage tripler circuit CR-17, CR-18 and CR-19 to supply approximately +450 volts to the transmitter tubes and +150 volts to the screen grids of V-2 and V-3. Another small secondary winding is half-wave rectified by CR-20 to supply negative bias to the transmitter tubes.



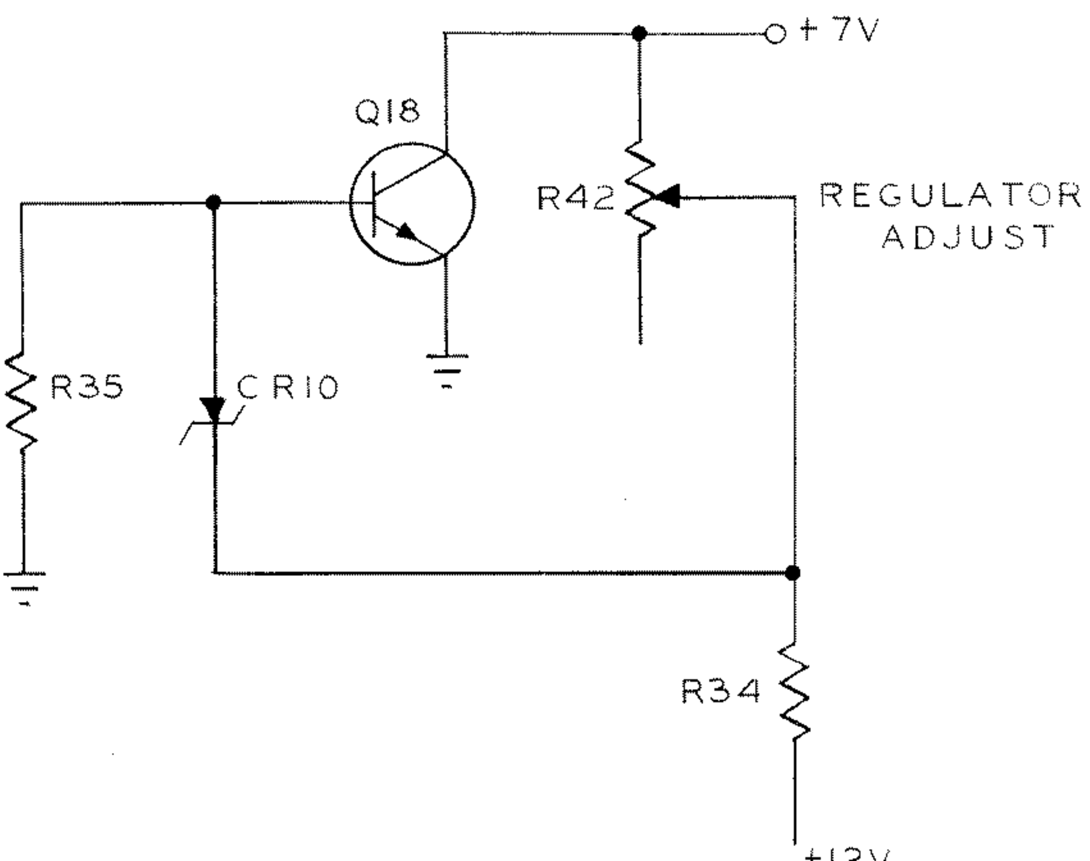
2.11.1 Power Supply AC Operation. (Refer to diagram below)

With 117volt AC operation, T-7 is energized by a second primary winding. The feedback and collector windings of the transformer are connected essentially in series and full-wave rectification by the collector-base diodes of Q-21 and Q-22 provides a high-current +12 volts output. This voltage is used to operate the transistorized stages and operate the transmitter tube heaters. The high-voltage and bias circuits operate as described in DC operation (2.11). The XMTR switch, in this mode of operation is not connected; the transmitter tube heaters are energized at all times.



2.12 Voltage Regulator. (Refer to diagram below)
A special regulator circuit is provided to stabilize the voltage to the VFO, Q-14 and Q-15. Regulator Q-18 operates as a shunt regulator across the +12 volt bus to provide an output of +7.0 volts. The voltage to the base of Q-18 is determined by the current flow through zener diode CR-10, and since this zener diode in itself is not a perfect regulator, the output voltage from Q-18 would normally vary slightly as the supply voltage changed. To overcome this variation, a small variable resistor is inserte in the series-dropping resistor line to the regulator transistor. The effect of this variable resistor is to insert an additional amount of base current to the transistor to offset the slight change that occurs in the zener diode due to supply-voltage changes. Thus, with proper adjustment of the resistor, regulation becomes perfect for input supply voltages of 11.5 to 15.0 volts.

VOLTAGE REGULATOR



3. MAINTENANCE, ALIGNMENT AND TROUBLESHOOTING GUIDE

3.1 TROUBLE SHOOTING SECTION
Equipment Required

Vacuum Tube Voltmeter:

0-100V @ 25 Mcs R-F
Peak Reading - Calibrated in RMS
± 3% Full Scale
Input Resistance - 10 megohms
Input Capacitance - 1.5 pf
Recommend -- Hewlett Packard Model 410-B

Two Tone Generator:

Capable of 1000 cps and 1700 cps
Two-Tone output @ 15 millivolts
Recommend -- Heath Kit Model HO-10 combination Oscilloscope and Two-Tone Generator

Oscilloscope:

(If HO-10 is not used) Capable of accurately presenting wave forms to 25 mc

Dummy Load

52 ohm non-reactive - 1KW
VSWR not to exceed 1.5:1
Recommend -- Waters Model 334

Signal Generator:

Range 3.7 mc - 21.50 mc
50 ohm output
Output accurately calibrated down to 1 microvolt
Recommend -- Measurements Model 65B

Power Source:

Variac 90-120 VAC, with 0-3 amp meter
Variable DC 10-15 volts @ 15 amps

Receiver:

Coverage from 5.5 to 5.75 mc
(Stability is more important than dial accuracy)

Special Tools:

Non Metallic Hex alignment tool for upper and lower slugs of IF cans
Recommend -- General Cement GC 8606
Non Metallic 8" screwdriver
Recommend -- General Cement GC 8988

VOM:

Simpson Model 260 or equivalent

MISC:

SB-2-XC Crystal Calibrator
SB-2-MIC Dynamic Microphone

3.2 PRELIMINARY CHECKOUT

Control Settings:

Volume	Fully CCW
Pitch Switch	Off
Pitch Control	Center of Range
Dial Correct	Center of Range
Mic Gain	Fully CCW
PA Load	Fully CCW
PA Tune	Fully CCW
USB/LSB	USB
Tune/Oper Switch	Oper
Meter Switch	Ip

NOTE: The trouble shooting chart for this section is on the next two pages.

1. Plug unit in to variac and apply power - adjust variac to 120 VAC.
2. Turn volume control on. Total line current should not exceed .7 amp AC.
   A. If total line current exceeds .7 amps, a short circuit probably exists. See the trouble shooting chart "Excessive Line Current". If no short exists, check to see that the transmitter is not being keyed by either front panel controls, grounded - 70V line, or faulty keyers.
3. Advance volume control to full CW. Adjust bandswitch for a noise peak on 40 meter band.
   A. If no noise peak is obtainable, see trouble shooting chart "No Noise Peak". The audio circuit may be quickly checked by placing one finger on the base of Q-2 and briefly touching your other hand to the collector of Q-20 (audio power amp). A loud squeal will result if the circuit is operating.
4. Connect dummy load, scope and VTVM to the antenna jack and connect the two-tone signal from the monitor scope to the microphone connector.
5. Key the transmitter by grounding the -70V line at the microphone connector.
   A. If the transmitter fails to key, refer to the trouble shooting chart "Transmitter Will Not Key". A meter indication of 100ma will indicate proper idle current of the PA Tubes.
6. Advance mic gain halfway and tune transmitter as described in "Operation" section.
   A. If the plate current can not be peaked by the exciter tune or no increase is evident as mic gain is advanced, refer to trouble shooting chart. If the receiver has already been checked and is operating properly, the possibility of faulty oscillators may be eliminated. The voltages in the trouble shooting chart are approximate and are measured with bandswitch control on receiver noise peak.
7. This completes the preliminary checkout.

Once the preliminary checkout has been completed, it may be assumed that the unit has been cleared of any basic troubles. Specific troubles will be covered as the alignment procedure is performed. It is recommended that the receiver alignment is performed first, even if the complaint is in the transmitter. This will insure correct adjustment of the various injection oscillators and IF transformers which is necessary for proper transmitter alignment.

3.2.1 TROUBLESHOOTING GUIDE

(Refer To Section 4 For Test Point Location)

Complaint or Symptom	Probable Cause	Component/Check
Excessive Line Current	B+ short-check to see that HV Test point is 50K ohms in 10 seconds.	
	Power inverter short	Q-21, Q-22, C-67, C-68
No Noise Peak	456 OSC-Testpoint (1) should be at least 1.0 volts rms	Y-1, Q-12
	Doubler-Doubler/Tripler-Test point (2) should be at least .5 volts rms	Check alignment, Q-13, CR-8
	VFO-Test point (3) should be at least .12 volts rms	Q-15, Q-14 L-4 Misaligned
	HF OSC - Testpoint (4) should be at least .2 volts rms	Q-19, L-6 misaligned. Poor ground on PC Board
	Keyers open-Test points (5) & (6) should be: (5) .2 VDC or less (6) 12 VDC minimum	Q-16, Q-17
	Shorted mixer transistor	Q-7, Q-8, Q-9, Q-10
	Shorted 456 amp.	Q-5, Q-6
	Defective audio circuit	Q-2, Q-1, Q-20 (Q-4 shorted)
No Noise Peak On One Band	No high frequency oscillator injection on the applicable band Tp (4)	Y-2, Y-3, Y-4, Y-5 Alignment of C-80 C-81, C-82, C-79, or L-6
Transmitter Will Not Key	Defective keyer V-1 not conducting, 70V line not grounded	Q-16 V-1 Microphone
	No B+ to V-1	B+ supply
Transmitter Keys But Will Not Tune	No RF drive	
	MIC amp inoperative -- check for a change from 0-.2 VAC at TP-10 as mic gain is rotated from min. to max.	Q-4, C-10, C-6

Complaint or Symptom	Probable Cause	Component/Check
Transmitter Keys But Will Not Tune	456KC amp inoperative -- check for a change from 0-2 VAC at TP-11 as mic gain is rotated from minimum to maximum.	Q-5
	VFO mixer inoperative -- Check for a change from 0-.25 VAC at TP-12 as mic gain is rotated from minimum to maximum.	Q-7
	HF mixer inoperative -- Check for a change from .2 to 1.8 VAC at TP-13 as mic gain is rotated from minimum to maximum.	Q-9
	Driver inoperative -- set mic gain control for max-check for up to 15 VAC RF at TP-14	V-1, C-90C, L-7, L-14
	PA circuit inoperative with mic gain set at maximum. Check for up to 54 VAC RF at Output Connector	V-2, V-3, C-78, C-76, L-9, S-7

3.3 ALIGNMENT SECTION

If, in following this procedure, a specified voltage can not be obtained or a condition satisfied, refer to that section of the "Alignment Trouble Shooting Chart" which corresponds to the number preceeding the alignment step. Refer to Section 4 for component and test point locations. Check to see that the controls are set as follows:

Volume------------------------------Fully CCW
Pitch Switch------------------------Off
Pitch Control-----------------------Center of Range
Dial Correct------------------------Center of Range
Mic Gain----------------------------Fully CCW
PA Load-----------------------------Fully CCW
PA Tune-----------------------------Fully CCW
USB/LSB Switch----------------------USB
Cal Switch--------------------------Cal
Xmtr Switch-------------------------Xmtr
Tune/Oper---------------------------Oper
Meter Switch------------------------Ip

Set internal adjustments for the following positions only if previous alignment has been attempted or the unit has been tampered with:

Bias Pot. (R-81) -- Fully CCW (Located inside PA cavity)
Regulator Control (R-42) -- Center of range (Located on left rail)
Receiver Zero Pot. (R-58) -- Center of range (Under chassis below VFO Board)
Neutralizing Cap (C-86) -- Screw end to be 5/8" from mounting surface
Tuner Slug Screws -- Screw end 1/8" from edge of rack
24mc Trap (L-10) -- Slug even with edge of terminal ring

3.3.1 PROCEDURE

NOTE: All measurements taken with 120 VAC line voltage

3.3.1.0 VOLTAGE TESTS -- Turn volume control to ON.
3.3.1.1 Measure voltage at Red Bus on Tuner Board. With input voltage set at 120 volts Red Bus voltage should be 11vdc minimum.
3.3.1.2 Measure voltage at Gray Bus on Tuner Board (TP-6). Should be 11vdc minimum.
3.3.1.3 Measure voltage at Blue Bus on Tuner Board (TP-5). Should be 0.2vdc maximum.
3.3.1.4 Measure voltage at Purple Lead on Tuner Board. Should be -70V minimum.
3.3.1.5 Measure voltage on Plates of PA Tubes. Should be 480vdc minimum.

3.3.2.0 RECEIVER ALIGNMENT -- VTVM refers to HP-410B using R-F probe.
3.3.2.1 Connect VTVM to TP-1 (center of carrier balance pot.). Voltage should be 1.0 volts minimum.
3.3.2.2 Connect VTVM to collector of Q-13. Align both slugs of T-4 for maximum reading. Make sure that slugs are on outside of coils.
3.3.2.3 Connect VTVM to TP-2 (IF Board). With USB/LSB switch in USB position, align both slugs to T-5 for maximum reading. Then switch to LSB and align both mica compression trimmers (C-32 and C-33) for maximum output. If the reading with the switch in LSB exceeds .5 volts, screw the bottom slug of T-4 into the coil until a reading of .5 volts is obtained. Place switch in USB position and note the reading. If this reading is less than .6 volts, screw the bottom slug of T-4 out of the coil until .6 volts is obtained. Switch to LSB and adjust C-33 until a reading of .5 volts is obtained. If the USB reading exceeds .6 volts, screw the top slug of T-5 out of the

coil until .6 volts is obtained. (If this adjustment is required, retune the mica compression trimmers with the switch in LSB, for maximum output.) Final output voltages should be .6 volts for USB and .5 volts for LSB.

3.3.2.4 Set the tuning dial to 7.15mc (40 meters). Connect the VTVM to the rear stator lug of the small 3-gang capacitor (C-48C). A reading of .5 to .8 volts indicates correct VFO operation.

3.3.2.5 Connect the VTVM to the rear inboard lug of L-4 (TP-3). Screw L-4 slug to the clockwise limit and then counter-clockwise until a reading of .12 volts rms is obtained.

NOTE: In units with chassis #12 or below, this reading may only decrease to .4 volts.

3.3.2.6 Loosely couple the antenna of monitor receiver to the VFO output. (Recommend clamping alligator clip over C-43). Check to see that dial reading of unit under test reads between 7.15 and 7.2. Adjust the monitor receiver until a beat note is heard (approximately 200 cps). Vary the line input variac between 95-120 VAC. Adjust the regulator control (R-42) so that the beat note remains the same as the variac is swung from 95-120VAC.

3.3.2.7 Put the set in tune position. If the beat note changes, adjust the monitor receiver as required to return it to 200 cps. Check to see that the pitch switch is off. Unkey the transmitter and adjust the receiver zero pot. (R-59) until the beat note is the same as with the transmitter keyed. Key and unkey the transmitter several times to assure that beat note remains the same.

3.3.2.8 With the transmitter unkeyed, turn the pitch switch on. See that the pitch control will vary the beat note at least 300 cps above and below the note obtained with the transmitter keyed. Turn off pitch switch.

3.3.2.9 With the transmitter keyed, test the dial correct control. It should be possible to vary the beat note at least 1500 cycles above and below the note obtained with the dial correct knob centered. Remove the monitor receiver hookup. Unkey the transmitter.

3.3.2.10 Connect VTVM to TP-4 on the high-frequency oscillator board. Turn the bandswitch to 15 meters. Adjust coil slug (L-6) for a meter reading of .24 volts. (NOTE: The slug will usually tune out of the coil for this reading in units with chassis numbered 20 and above - refer to modification section). Turn the bandswitch to 20m and back to 15m several times to make sure that the oscillator starts reliably.

3.3.2.11 Turn the bandswitch to 20 meters and adjust C-80 trimmer (located in PA cavity) for a reading of .24 volts.

3.3.2.12 Turn the bandswitch to 40 meters and adjust C-81 for a reading of .24 volts.

3.3.2.13 Turn the bandswitch to 80 meters and adjust C-82 for .24 volts. Check to see that the oscillator starts reliably on all bands and that output on all bands is .24 volts. Remove the VTVM leads.

3.3.2.14 Connect the signal generator leads to the antenna jack and an AC voltmeter to the external speaker terminals on the rear panel. Set the bandswitch knob to the center of the 15 meter arc. Set the tuning dial to 21.30mc. Tune the signal generator (with modulation off) near 21.30mc until a beat note of about 400cps is heard. Adjust signal generator attenuator for an audio output meter reading of .2 volts or less with volume control fully clockwise. Adjust the PA tune and PA load controls for maximum audio output. Peak the front and center trimmers on the large 3-gang capacitor (C-90A and B) for maximum output. Reduce the generator output as required to keep audio meter reading below .2VAC. Tune both slugs of T-3 and T-6 and the single slug of T-2 for maximum output. Final audio output shall be 1 volt for an input of 1 microvolt. If the required sensitivity is achieved, proceed to 3.3.2.15.

NOTE: The following readings are approximate and should be used only as a general guide in locating a weak stage. The generator used had a 50 ohm output and a .03mfd isolating capacitor in series with signal input line.

3.3.2.14.1 Connect signal generator to the base of Q-6 (TP-7). Adjust generator around 456KC until a beat note is heard. With 15 microvolts ±30% input at this point, .5 volts audio should appear at the speaker output.

3.3.2.14.2 Connect signal generator to the base of Q-8 (TP-8). Adjust generator between 3175KC and 3425KC until a beat note is heard. With 7.5 microvolts ±40% input, .5 volts audio should appear at the speaker output terminals.

3.3.2.14.3 Connect signal generator to the base of Q-10 (TP-9). Adjust generator to dial frequency until a beat note is heard. With 1.1 microvolts, ±40% input, 1 volt should appear at the speaker output terminals.

3.3.2.14.4 Connect signal generator to antenna input jack. Adjust generator to dial frequency until a beat note is heard. With 1 microvolt input, 1 volt should appear at speaker output terminals.

3.3.2.15 Set bandswitch to 80 meters with index 1/8" from the clockwise edge of the 80 meter arc. Set the tuning dial to 3.80mc. Adjust the signal generator near 3.8mc until a beat note is heard. Reduce attenuator as required to keep audio down to .2 volts. Adjust the center and front slugs on the tuner board (L-2 and L-3) for maximum audio output. Adjust PA load and PA tune controls for maximum output. Final audio output should be 1.5 volts for an input of 1 microvolt.

3.3.2.16 Check 40 meter receiver operation by tuning set and signal generator to 7.10mc and adjusting bandswitch, PA load and PA tune controls for maximum output. Final audio output should be 1 volt for an input of 1.0 microvolt.

3.3.2.17 Check 20 meter receiver operation by tuning set and signal generator to 14.2mc and adjusting bandswitch, PA load and PA tune controls for maximum output. Final audio output should be 1.5 volts for an input of 1 microvolt.

3.3.2.18 This completes receiver alignment. Remove signal generator and audio output meter leads.

3.3.3.0 TRANSMITTER ALIGNMENT -- Measurements made with HP-410B -- Line voltage 120 VAC.

3.3.3.1 Connect dummy load and monitor oscilloscope to antenna jack. Connect VTVM across antenna jack. Adjust scope for clean two-tone output @ .015 volts and connect to microphone jack on the transceiver. Set frequency to 21.30mc. Set bandswitch to 15 meters and adjust to the point of maximum receiver noise.

3.3.3.2 Key the transmitter. With the mic gain control fully CCW, adjust the bias pot. (R-81) for a total line current of 1.2 amps AC (plate current meter should read between 1.0 and 1.5).

3.3.3.3 Advance the mic gain control to mid-scale, set PA tune CCW, and adjust the rear trimmer on the large 3-gang capacitor (C-40C) for maximum front panel meter reading. If the scope pattern shows signs of self-oscillation at this point, adjust the neutralizing capacitor (C-86) as required to prevent it.

3.3.3.4 Adjust the PA tune and PA load controls for maximum transmitter output, and advance the mic gain control as required to keep the transmitter scope pattern at the point of flat-topping. (NOTE: Always approach PA resonance from the CCW position. The output obtained at the extreme CW position of the PA tune control is incorrect). If signs of instability show, readjust the neutralizing capacitor as required. Adjust slightly the front trimmer of the large 3-gang capacitor (C-90A) for maximum output. After the above mentioned adjustments have been completed, with the mic gain set just at the point of flat-topping, the VTVM should read at least 45 volts rms with 120 volts line voltage. If the required output is achieved, proceed to 3.3.3.5.

NOTE: The following readings are approximate. Keep in mind that a lower than average reading from a particular stage may be compensated for if the following stages have higher than average gain. Tune transmitter for maximum output, then rotate PA tune fully CCW before taking readings. Do not leave transmitter keyed in this condition for more than 30 seconds.

3.3.3.4.1 With the transmitter keyed and mic gain at maximum CW, check for .26 volts AC ±40% at TP-10. If this reading is obtained, adjust mic gain control so that TP-10 is .2 volts and go to 3.3.3.4.2.

3.3.3.4.2 Connect VTVM to TP-11 (filter input). Check for 1.9 volts AC ±20%.

3.3.3.4.3 Connect VTVM to TP-12. Check for .26 volts AC ±30%.

3.3.3.4.4 Connect VTVM to TP-13. (Driver tube grid) Check for 1.9 volts RF ±15%.

3.3.3.4.5 Connect VTVM to TP-14 (PA tube input). Check for 15.5 volts RF ±15%.

3.3.3.4.6 Connect VTVM across output connector and tune PA controls for maximum output. Voltage should be at least 45 volts RF.

3.3.3.5 Turn the mic gain control fully counter-clockwise and adjust the PA tune control clockwise until a peak occurs on the VTVM. Then adjust L-10 (24mc trap) for minimum VTVM reading. This reading should be 2.0 volts or less.

3.3.3.6 Retune transmitter and advance the mic gain control to the point of flat-topping. Adjust neutralizing capacitor C-86 until maximum output and minimum plate current occur at the same setting of the PA tune control. In order to determine the correct direction in which to turn the neutralizing capacitor, the following test may be made: Dip the plate current. Then rotate the PA tune control in the direction which produces maximum VTVM reading. If this direction is clockwise, the neutralizing capacitor must also be rotated clockwise.

3.3.3.7 Turn the mic gain control fully counter-clockwise and adjust the carrier balance pot. R-25 and trimmer capacitor C-23 for minimum VTVM reading. The final reading should be .4 volts or less with the USB/LSB switch in either position.

3.3.3.8 Set the Bandswitch knob to 40 meters on receive noise peak. Set the tuning dial to 7.075mc. Advance the mic gain to mid-scale, and adjust the rear slug on the slug rack (L-7) for maximum VTVM reading. Adjust the PA tune and PA load controls for maximum VTVM reading advancing the mic gain control as required to keep the scope pattern at the point of flat-topping. The VTVM reading should be at least 54 volts with 120 volts line voltage.

3.3.3.9 Test 80 meter operation by adjusting the bandswitch knob on noise peak and PA tune and PA load controls for maximum output at 3.8mc. The bandswitch knob setting must coincide very closely with the setting that produces maximum receiver noise. If necessary, a compromise rear-slug setting must be made to provide good receiver sensitivity and transmitter drive at the same setting of the bandswitch knob on both 40 and 80 meters. After completing the adjustments, with the mic gain control advanced to the point of flat-topping, the VTVM reading on 80 meters should be at least 50 volts with 120 volts line voltage.

3.3.3.10 Test 20 meter operation by adjusting the bandswitch knob for maximum drive and the PA load and PA tune controls for maximum output at 14.25mc. The bandswitch knob setting must coincide very closely with the setting that produces maximum receiver noise. With the PA tune and PA load controls adjusted for maximum output, there should be no signs of transmitter instability. Readjust the neutralizer if required on 20 meters to obtain stable operation and a clean two-tone pattern on the scope. Transmitter output with 120 volts line voltage and the mic gain control set at the point of flat-topping should be 54 volts minimum on 20 meters.

3.3.3.11 Test to see that transmitter output is equal with the USB/LSB switch in either position. Test operation of the Tune/Oper switch by removing the two-tone signal and setting the Tune/Oper switch to tune. The scope pattern should be a solid bar with RF output voltage essentially equal to that obtained with a two-tone test signal.

3.3.3.12 Measure voltage at the linear amp receptacle on rear panel (TP-15) Voltage should be approximately 12 volts DC when the transmitter is keyed.

3.3.3.13 Attach the 100KC crystal calibrator to the rear panel receptacle. Place the USB/LSB is USB. Check to see that the pitch switch is OFF and the dial correct is in the center of its range. Turn the Cal switch to ON. Set the band switch to 15 meters and adjust for maximum noise. Set frequency below 21.20mc. Rotate the frequency dial toward 21.20mc. A beat note should be heard near 21.20 and should zero on the frequency dial mark for that frequency. Adjust C-54 until this result is obtained. Advance dial and listen for the next beat note at 21.30 and 21.40. Do not readjust C-54. Check to see that the beat note appears at the 100KC points on 20M, 40M and 80M. It should be possible to zero beat these points within the range of the front panel dial correct control.

3.3.4.0 Connect unit to 14.6 volt DC source with proper power cord. See that receiver operation is normal. Turn the "XMTR switch" to ON. The power inverter should start and tube filiaments should come on. A buzz from the speaker is normal when the inverter is operating.

3.3.4.1 Test the transmitter operation. The output should be essentially the same as with AC operation. 14.6 volts line input should be measured <u>at the set</u> when making transmitter power measurements in DC operation.

3.4 ALIGNMENT TROUBLE SHOOTING CHART

Unable to Obtain Requirement at Step Number		Check
3.3.1.2	Indicates faulty keyer	Q-16
3.3.1.3	Indicates faulty keyer	Q-17
3.3.1.4	Indicates improper bias voltage	Bias supply, shorted tubes
3.3.1.5	Indicates faulty B+ supply	
3.3.2.1	Insufficient output from 456 kc osc.	Q-12, T-1
3.3.2.2	No reading indicates faulty doubler	CR-8, T-4 Q-13
3.3.2.3	Unable to obtain correct readings	T-5, Q-13
3.3.2.4	IF reading exceeds 1.0 volt, replace Q-15	
3.3.2.6	Unable to obtain flat beat note	CR-10, Q-18
3.3.2.7	Unable to obtain flat beat between TX and RX	CR-12, CR-13
3.3.2.8	Pitch control limited range or inoperative	CR-11, S-3, R-59
3.3.2.9	Dial correct limited range or imoperative	CR-11, R-60
3.3.2.10	Crystal osc. inoperative or low output	Poor ground on PC Board Q-19, Y-5, L-6
3.3.2.11	20 meter injection low or inoperative	Y-4
3.3.2.12	40 meter injection low or inoperative	Y-3
3.3.2.13	80 meter injection low or inoperative	Y-2
3.3.2.14	Sensitivity low	
3.3.2.14.1	Insufficient gain in 456 amp or audio ckts. Note: to check AGC circuit, remove Q-3 and note output meter. If the reading increases, fault is in the AGC circuit	Q-6, Q-2, Q-1, Q-20, C-16 C-10, Q-3, C-2, C-8
3.3.2.14.2	Insufficient conversion gain	Q-8, T-6, T-3 CR-9
3.3.2.14.3	Insufficient conversion gain	Q-10, Q-11, L-2, T-6
3.3.2.14.4	Insufficient R-F amplification	Q-11, C-3 CR-14, CR-15
3.3.2.15-2.17	IF readings cannot be obtained, recheck alignment	
3.3.3.2	PA idle current low	V-2, V-3
3.3.3.3	Unit won't neutralize-check to see that driver tube shield is making good ground	C-86, V-2, V-3
3.3.3.4.1	Check for adequate two-tone input Should be .015 volts.	Q-4, Mod # 5.1.6 C-10, C-6, C-18
3.3.3.4.2	456 amp weak	Q-5, T-2
3.3.3.4.3	Insufficient conversion gain	Q-7, T-3, T-6
3.3.3.4.4	Insufficient conversion gain from HF mixer or shorted Q-11, Q-10	Q-9, Q-10, Q-11 V-1, L-2, L-3 C-90, A and B
3.3.3.4.5	Insufficient drive from V-1	V-1, C-90C L-7
3.3.3.4.6	Low output Note: B+ should not go below 350 volts DC measured at the high voltage test point under full load	V-2, V-3, Output Circuits Low B+

3.4 ALIGNMENT TROUBLE SHOOTING CHART
(Continued)

Unable to Obtain Requirement at Step Number		Check
3.3.3.5	If a sharp dip cannot be obtained, replace L-10 or C-65. If dip is not low enough, try to neutralize first.	
3.3.3.6	Insufficient control from C-86. Check first to see that driver tube shield is making a good ground.	C-86, C-90C Tuning V-2, V-3
3.3.3.7	Excessive residual carrier. Any stage producing noise sufficient to excite the final amplifier will cause this reading to be higher than specified. Be sure that no audio is leaking into the unit while this measurement is being made. If no dip can be obtained with the carrier balance pot., change all the diodes in the balanced modulator.	
3.3.3.11	No indication in tune	Faulty tune switch, C-13, open
3.3.3.12	Continuous output	Q-23 shorted
3.3.3.13	Dial nonlinear	Bend rear rotor plate on C-48 accordingly
	20, 40 or 80 doesn't fall within limits of dial correct control	Adjust appropriate crystal trimmer slightly. If the adjustment results in less than .2VAC injection at TP-4, replace the crystal.
3.3.4.0	Inverter won't start	Q-21, Q-22, C-67 C-68, T-7

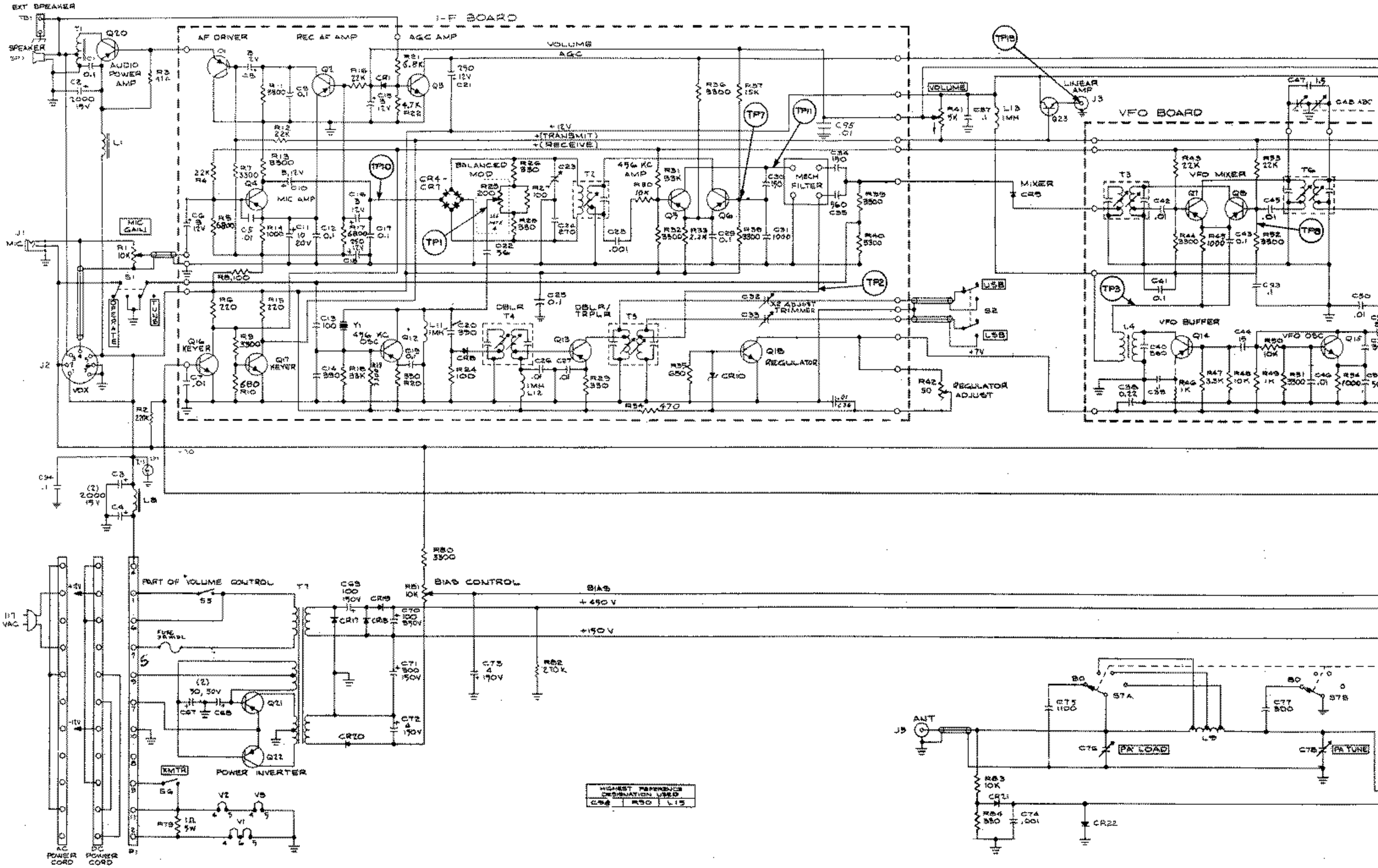
3.5 TRANSISTOR VOLTAGES

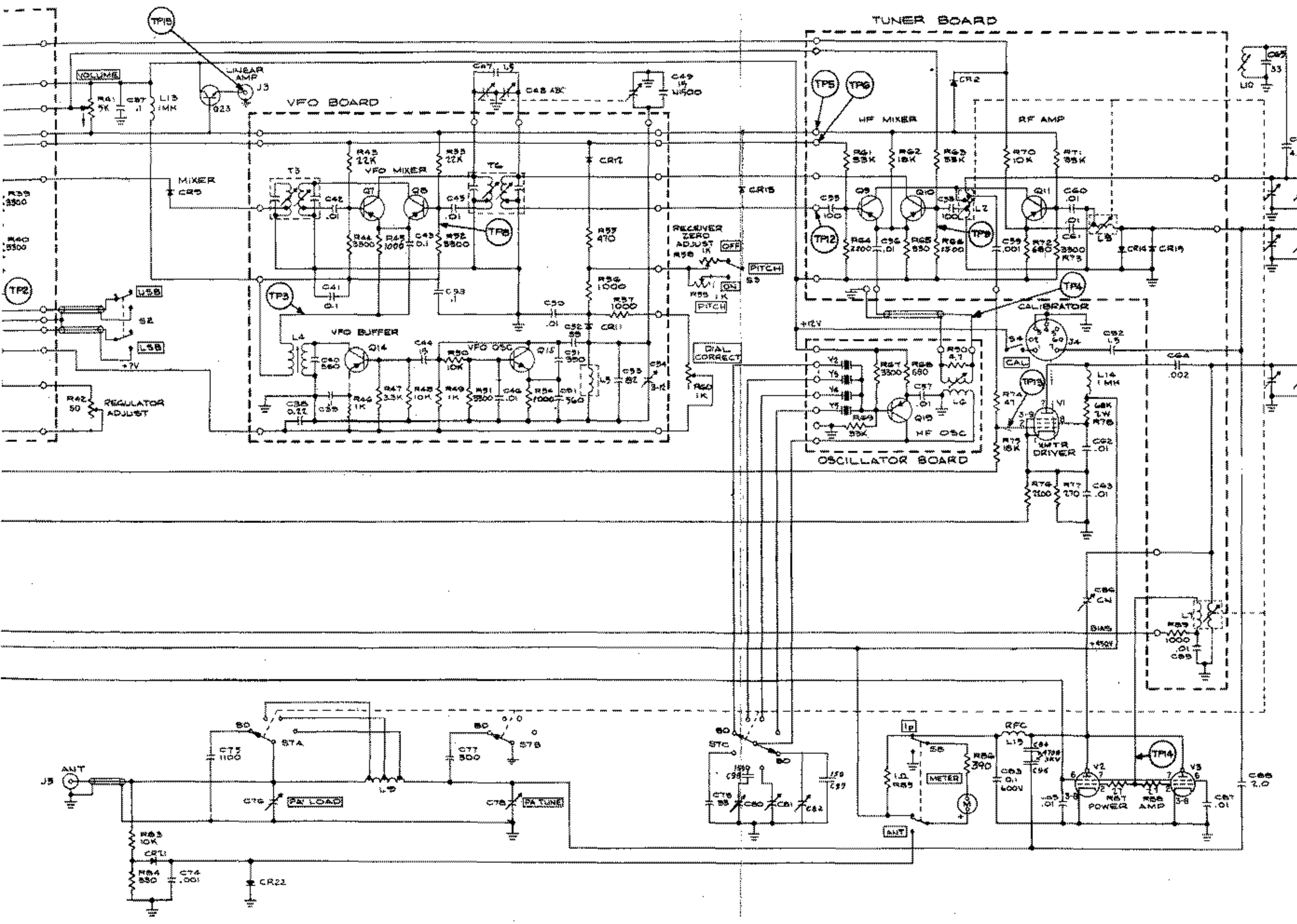
Symbol	Type No.	Base	Emitter	Collector	Measured In
Q-1	2N2431	10.7	11.1	0	Receive*
Q-2	2N3638	10.3	11.0	7.9	Receive*
Q-3	2N3642	0	0	11.1	Receive*
Q-4	2N3638	10.7	11.5	8.1	Transmit
Q-5	2N2672	12.1	12.4	0	Transmit
Q-6	2N2672	10.3	10.6	0	Receive
Q-7	2N2672	11.6	11.9	0	Transmit
Q-8	2N2672	11.0	11.3	0	Receive
Q-9	2N2672	12.5	12.8	0	Transmit
Q-10	2N2495	12.0	12.2	0	Receive
Q-11	2N2672	11.7	12.0	0	Receive
Q-12	2N2672	10.5	10.1	0.1	Receive
Q-13	2N2672	12.8	12.6	0	Receive
Q-14	2N2672	5.2	5.5	0	Receive
Q-15	2N706	1.43	0.81	5.8	Receive
Q-16	2N3642	-1.02	0	12.1	Receive
Q-17	2N3642	.94	0	.12	Receive
Q-18	2N2926	.58	0	7.1	Receive
Q-19	2N2672	11.6	10.5	0	Receive**
Q-20	2N2869/2N301	10.4	10.7	.63	Receive
Q-21	2N443	14.5	12.8	10.0VAC	Receive
Q-22	2N443	14.5	12.8	10.0VAC	Receive
Q-23	2N2926	13.6	13.1	13.6	Transmit

Measurements taken with 20,000 ohms-per-volt meter, no signal input, set powered from 120 volt AC.

* Volume control full clockwise.

** On 20 meter band


EXT SPEAKER
SPEAKER
AUDIO POWER AMP
I-F BOARD
AF DRIVER
REC AF AMP
AGC AMP
VOLUME
AGC
MIC AMP
MIC GAIN
BALANCED MOD
456 KC AMP
MECH FILTER
+12V
+(TRANSMIT)
+(RECEIVE)
VOX
KEYER
456 KC OSC
DBLR T4
DBLR/TRPLR T5
REGULATOR
REGULATOR ADJUST
X2 ADJUST TRIMMER
LINEAR AMP
VFO BOARD
MIXER
VFO MIXER
VFO BUFFER
VFO OSC
USB
LSB
PART OF VOLUME CONTROL
BIAS CONTROL
BIAS
+490 V
+150 V
POWER INVERTER
XMTR
AC POWER CORD
DC POWER CORD
117 VAC
HIGHEST REFERENCE DESIGNATION USED
C98
R90
L15
ANT
PA LOAD
PA TUNE



NOTES

UNLESS OTHER WISE SPECIFIED:

1. CAPACITOR VALUES IN WHOLE NUMBERS ARE PICO-FARADS, DECIMALS INDICATE MICROFARADS.
2. RESISTOR VALUES IN OHMS ±10% 1/2 WATT.
3. INDUCTOR VALUES IN MICRO-HENRYS (μH)
4. R25, 400 BAL CONTROL IS NOT MOUNTED ON IF BOARD

SCHEMATIC DIAGRAM SB-34

Symbol	Stock No.	Description
		CAPACITORS
C1, 39, 41, 43, 93	235-7207P39	Ceramic, disc, .1mfd, 100V
C2, 3, 4	235-7215P43	Electrolytic, tubular, 2000mfd, 20V
C5, 7, 26, 27, 36, 42, 45, 46, 50, 56, 57, 60, 61, 62, 63, 85, 87, 89, 95	235-7207P29	Ceramic, disc, .01mfd, 300V
C6, 10, 15, 16	235-7189P1	Electrolytic, tubular, 3mfd, 12V
C8	235-7215P1	Electrolytic, tubular, 3mfd, 12V
C9, 12, 37, 94	235-7207P40	Ceramic, disc, .1mfd, 100V
C11	235-7189P4	Electrolytic, 10mfd, 20V
C13, 55, 58	235-7207P8	Ceramic, disc, 100pfd, 600V
C14, 20, 51	235-7053P313	Mica, dipped, 390pfd, 500V
C17, 29	235-7193P7	Mylar, dipped, .1mfd, 100V
C18, 21	235-7189P20	Electrolytic, tubular, 250mfd, 12V
C19, 25	235-7193P7	Mylar, dipped, 0.1mfd
C22	235-7207P6	Ceramic, disc, 56pfd, 600V
C23, 32	235-7263P1	Variable, mica, compression
C24	235-7053P279	Mica, molded, 270pfd, 500V
C28	235-7207P14	Ceramic, disc, .001mfd, 600V
C30, 34, 97, 98	235-7053P104	Mica, dipped, 150pfd, 300V
C31	235-7193P1	Mylar, dipped, 1000pfd, 100V
C35, 40, 91	235-7053P317	Mica, dipped, 560pfd, 500V
C38	235-7205P5	Mylar, dipped, .22mfd, 100V
C44	235-7196P61	Ceramic, disc, 15pfd, 500V
C47, 92	235-7200P6	Bakelite, tubular, 1.5pfd, 100V
C48A, B, C	235-7185P1	Variable, 3-gang VFO
C49	235-7207P3	Ceramic, disc, 15pfd, N1500
C52	235-7053P209	Mica, dipped, 39pfd, 500V
C53	235-7053P44	Mica, dipped, 82pfd, 2%, 500V
C54	235-7260P1	Ceramic, variable, 3-12pfd
C59, 74	235-7207P14	Ceramic, disc, .001mfd, 500V
C64	235-7195P60	Ceramic, disc, .002mfd, 1KV
C65, 79	235-7196P63	Ceramic, disc, 33pfd, NPO
C66	235-7200P4	Bakelite, tubular, 4.7pfd, 100V
C67, 68	235-7215P22	Electrolytic, tubular, 50mfd, 50V
C69	235-7215P32	Electrolytic, tubular, 100mfd, 150V
C70	235-7215P33	Electrolytic, tubular, 100mfd, 350V
C71	235-7215P39	Electrolytic, tubular, 300mfd, 150V
C72, 73	235-7215P3	Electrolytic, tubular, 4mfd, 150V
C75	235-7064P5	Mica, dipped, 1100pfd
C76	235-7267P1	Mica, variable, compression, PA load
C77	235-7210P5	Mica, "H" type, 300pfd, 2500V
C78	235-7186P1	Variable, PA tune
C80, 81, 82	235-7274P1	Mica, variable, compression, 3-sec.
C83	235-7212P14	Paper, tubular, .1mfd, 600V
C84, 96	235-7207P25	Ceramic, disc, .0047mfd, 3KV
C86	235-7259P1	Cermiac, neutralizing
C88	235-7053P0	Mica, dipped, 2pfd, 500V
C90A, B, C	235-7184P1	Variable, 3-gang
		DIODES
CR1, 2, 4, 5, 6, 7, 8, 21, 22	322-7186P3	Germanium, S262
CR9	322-7186P6	Germanium, 1N87A
CR10	322-7175P5	Zener, 7.0V, 5mA
CR11	322-7189P1	Silicon 1472
CR12, 13	322-7186P2	Germanium, 1N270
CR14, 15	322-7184P2	Silicon, planar, HE9010
CR17, 18, 19, 20	322-7180P1	Silicon, 1N2071
F1	226-1009P11	FUSE, 3 amp, MDL
I1	277-1013P1	LAMP, 28V, .17A bayonet

Symbol	Stock No.	Description
		SOCKETS
J1	276-7195P1	Microphone
J2, 4	282-7185P1	VOX & Calibrator, 7-pin, min, tube
J3, 5	276-7250P1	Antenna & Linear amp.
		COILS
L1	292-7200P1	Audio choke
L2	375-7223P1	Tuner (black dot)
L3	375-7223P2	Tuner (red dot)
L4	375-7260P1	VFO buffer
L5	375-7226P1	VFO
L6	375-7224P1	Crystal Oscillator
L7	375-7223P3	Tuner (orange dot)
L8	292-7184P1	Filter
L9	375-7221P1	PA tank
L10	375-7183P1	23 mc trap
L11, 12	375-7274P1	RF choke, 1mh
L31, 14	375-7178P1	RF choke, 1mh
L15	375-7220P1	RF choke
M	245-7181P1	METER
P1	276-7269P1	PLUG, power
		TRANSISTORS
Q1	386-7224P1	2N2431
Q2, 4	386-7184P1	2N3638
Q3, 16, 17	386-7185P1	2N3642
Q5, 6, 7, 8, 9, 11, 12, 13, 14	386-7219P1	2N2672
Q10	386-7223P1	2N2495
Q15	386-7222P1	2N706
Q18, 23	386-7214P1	2N2926
Q19	386-7184P1	2N3638
Q20	386-7200P1	2N2869/2N301
Q21, 22	386-7205P3	2N443 or AE443 Red
		RESISTORS
		All fixed resistors are 10% carbon, ½ watt unless otherwise noted on schematic.
R1	240-7180P1	Microphone gain control, 10K ohm
R25	240-7178P1	Carrier balance, 200 ohm
R41	240-7181P1	Volume control, 5000 ohm w/switch S5
R42	240-7196P1	Regulator adjust, WW, 50 ohm, 2W
R58	240-7206P1	Receiver zero adjust, WW, 1K ohm, 2W
R59	240-7179P1	Pitch control, 1000 ohm
R60	240-7179P1	Dial correct, 1000 ohm
R79	280-1106P1	Fixed WW, 1 ohm, 5W
R81	240-7221P1	Bias control, 10K ohm
		SWITCHES
S1	228-7280P1	Tune-Operate, DPDT slide
S2	228-7280P1	USB-LSB, DPDT slide
S3	228-7278P1	Pitch OFF-ON, SPDT slide, .5 amp, 125V
S4	228-7277P1	Calibrate, SPST slide, 1-amp, 125V
S5		Part of R41
S6	228-7279P1	Transmitter, SPST slide, 10-amp, 125V
S7, A, B, C	228-7194P1	Rotary Switch assembly
S8	228-7280P1	Meter, DPDT slide
SP1	352-7177P1	SPEAKER, 3.2 ohm

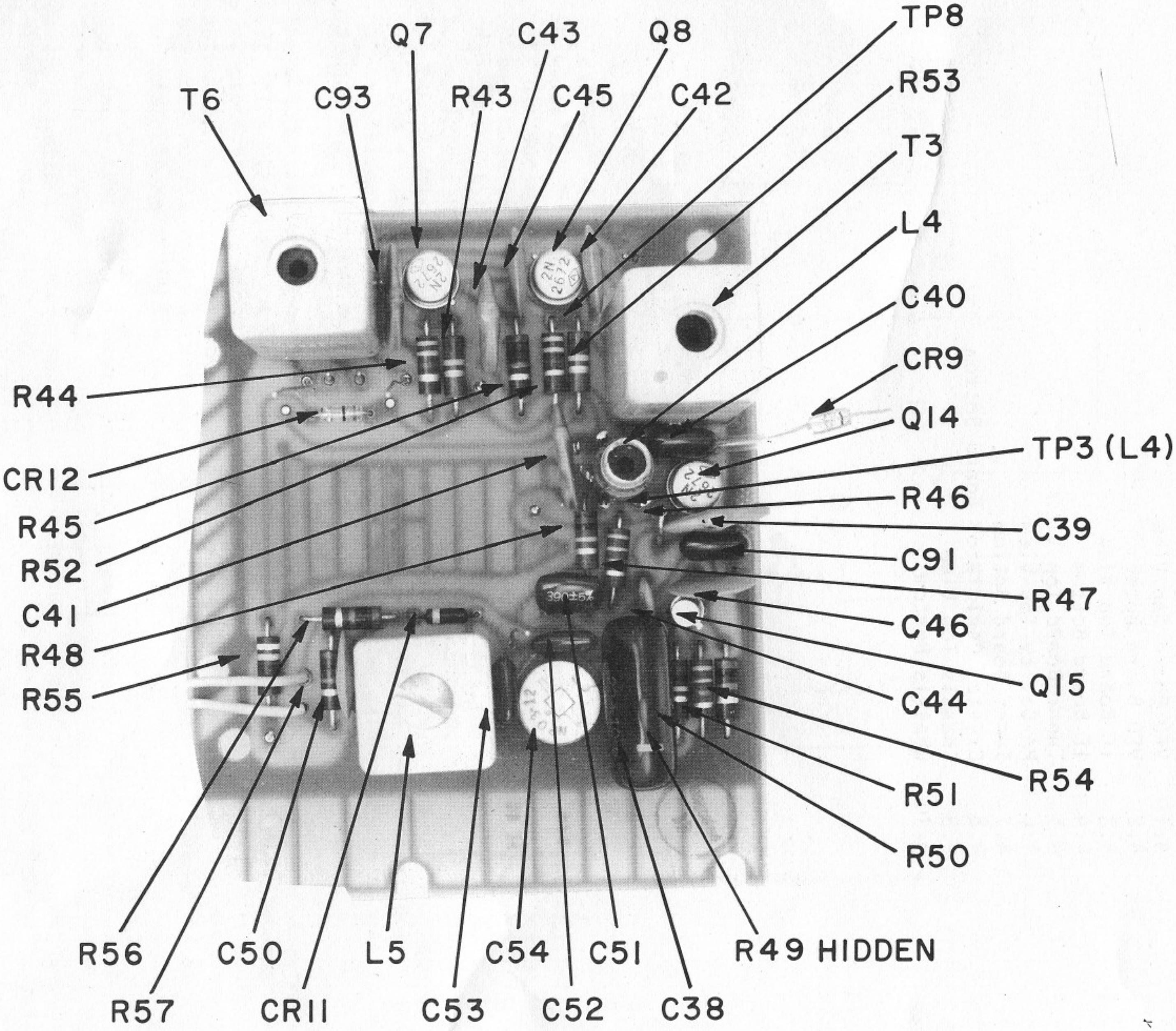
Symbol	Stock No.	Description
		TRANSFORMERS
T1	292-7199P1	Audio output
T2	375-7222P1	IF, 456KC (red dot)
T3	375-7222P4	IF, 2281.9KC
T4	375-7222P2	Doubler (green dot)
T5	375-7222P3	Doubler/Tripler (yellow dot)
T6	375-7222P5	IF, 3350KC
T7	292-7198P1	Power
		TUBES
V1	290-7247P2	12DQ7
V2, 3	290-7215P1	6GB5
		CRYSTALS
Y1	394-7189P1	456.38KC
Y2	394-7185P1	7200KC (80 meter)
Y3	394-7186P1	10475KC (40 meter)
Y4	394-7187P1	17525KC (20 meter)
Y5	394-7188P1	24625KC (15 meter)
		MISCELLANEOUS
	7267-5005G1	Cabinet, complete w/handle
	7267-7012P1	Cable, DC, W-70
	7267-7013P1	Cable, AC, W-71
	7267-1065P1	Clamp, Mech. Filter
	7267-1045P1	Dial, Frequency
	7267-1027P1	Dial, Bezel
	7267-1028P1	Dial, Window
	7267-1047G1	Geneva Wheel assembly
	7251-1021G1	Geneva Plate assembly
	7267-1042P1	Grill, speaker
	231-7221G1	Handle, w/mounting clips
	231-7192P4	Knob, small round
	231-7196P2	Knob, large round, tuning
	231-7191P2	Knob, pointer, bandswitch
	369-7174P1	Mechanical Filter
	7267-1026P1	Panel, front overlay
	7267-1035P1	Shaft, extension for C76
	7267-1063P1	Shield, top
	7267-1062P1	Shield, bottom
	7267-1064P1	Shield, VFO board
	386-7193P1	Socket, transistor, small
	386-7194P1	Socket, transistor, power
	282-7196P1	Socket, tube V-1
	282-7194P2	Socket, tube, V-2-3
		Tuner slug assembly parts
	297-7182P1	Ferrite slug (L-2-3-7)
	7251-1062P2	Slug connecting rod, nylon
	7267-1038P1	Yoke, wire
	7251-1024P1	Yoke, keeper wire
	7251-1026P1	Yoke, attachment bracket
	7267-1041P1	Vernier Drive, dual, ball
	7267-5016G2	I.F. Printed Circuit Board (less mechanical filter)

3.7 PROCEDURE FOR REPLACING VERNIER DRIVE

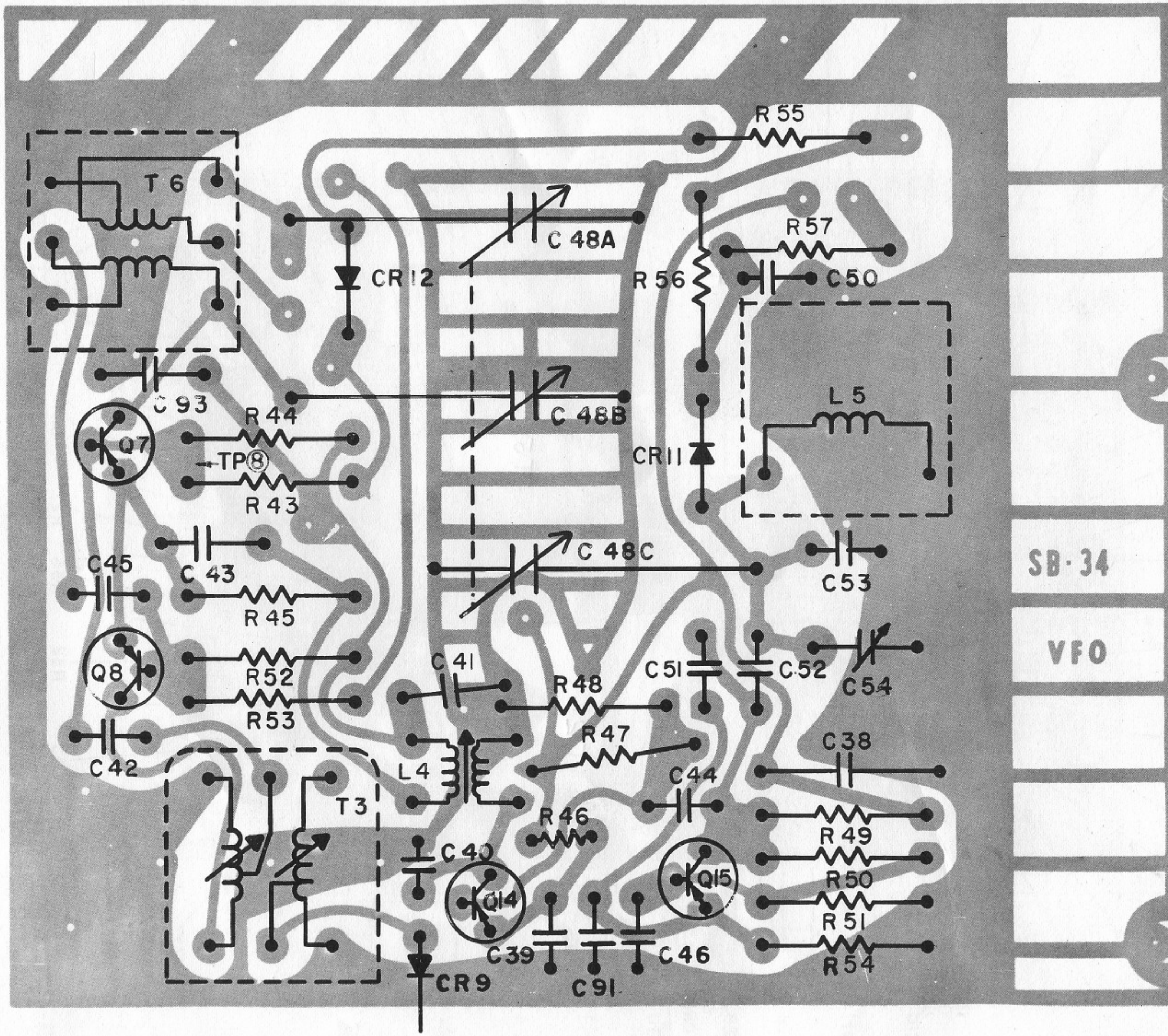
1. Remove all knobs on front panel.
2. Remove dial correct, pitch, volume and mic gain controls.
3. Remove the two forward most screws on both sides of the front panel and the one joining the upper right side to the top PA shield.
4. Loosen the two screws on the frequency dial collar.
5. Carefully pull the front panel away from the chassis along with the frequency dial.
6. Pull out far enough to allow the frequency dial to slip off the end of the vernier shaft.
7. Remove the two screws on the vernier drive mounting collar. (Put screwdriver through the hole in the front panel left by the shaft of the vernier drive).
8. Remove two set screws from rear (brass) collar of vernier drive unit and slip the entire unit off the shaft of the variable capacitor.
9. Enlarge the holes on the mounting collar of the new unit to the point where the former holes are now slots. The object is to insure that the mounting screws place no horizontal or vertical strain on the vernier drive coupling.
10. Install the new unit and tighten the set screws <u>first</u>.
11. Line up the mounting collar holes with the support bracket studs. If the holes in the collar don't line up, remove the vernier and enlarge the holes accordingly. Replace the mounting screws.
12. Slip the frequency dial back over the new shaft and move the front panel into place.
13. Replace the controls and the five mounting screws; be sure the front panel is vertical.
14. Rotate the 3-gang capacitor to full mesh. Align the mark at the high end of the dial card with the hair-line on the window and tighten the screws on the aluminum collar. Be sure the dial is clear of all other parts.
15. Re-calibrate the unit; replace front panel knobs.

NOTE: Later production units used a revised drive mounting bracket. If the vernier drive requires replacement in a unit with this new bracket, refer to the modification section and use the "Procedure For Installing Vernier Drive Modification Kit" as a guide.

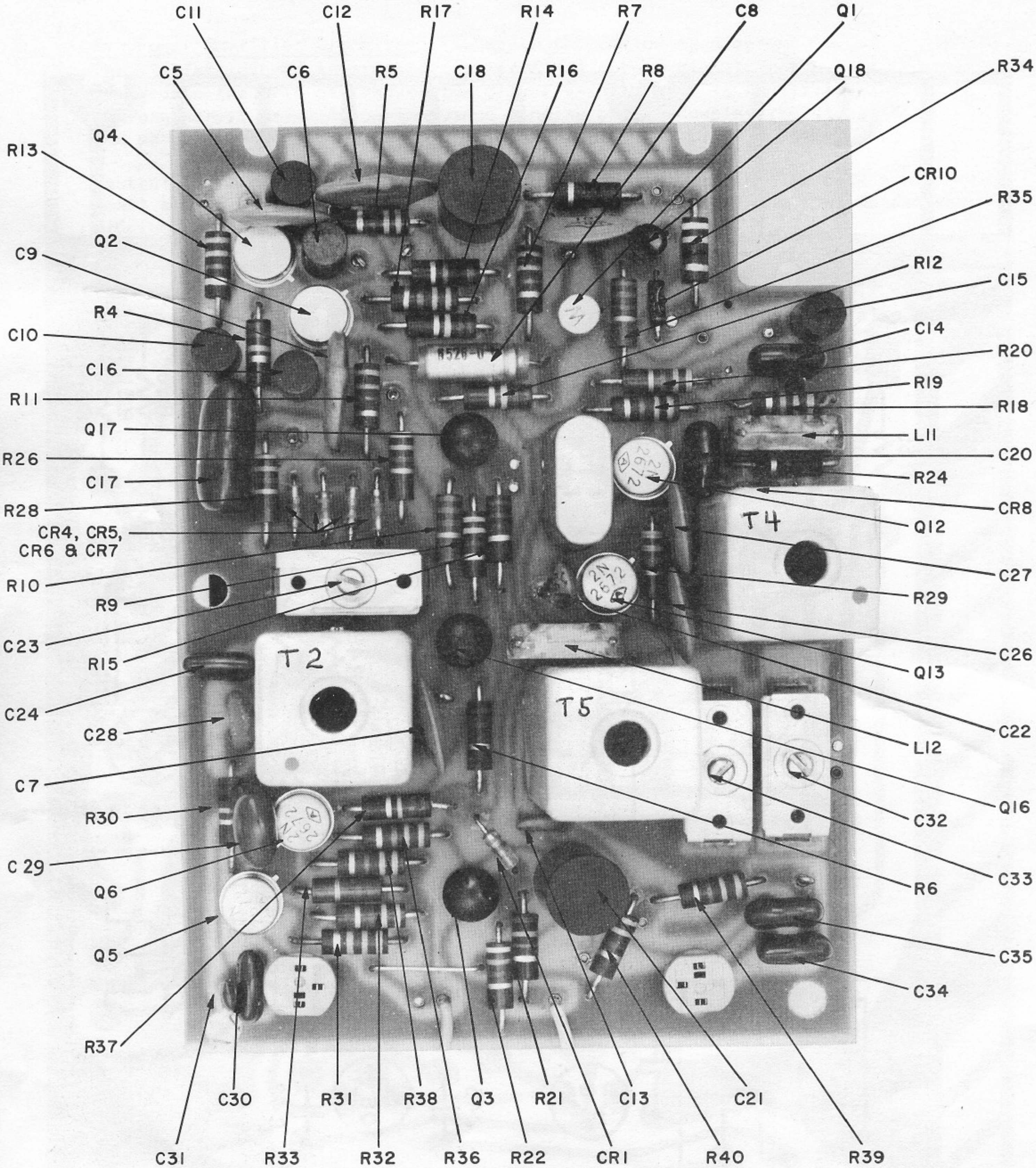
4. PARTS LOCATION DIAGRAMS


Q7
C43
Q8
TP8
T6
C93
R43
C45
C42
R53
T3
L4
C40
CR9
Q14
TP3 (L4)
R46
C39
C91
R47
C46
Q15
C44
R54
R51
R50
R44
CR12
R45
R52
C41
R48
R55
R56
C50
L5
C54
C51
R49 HIDDEN
R57
CR11
C53
C52
C38

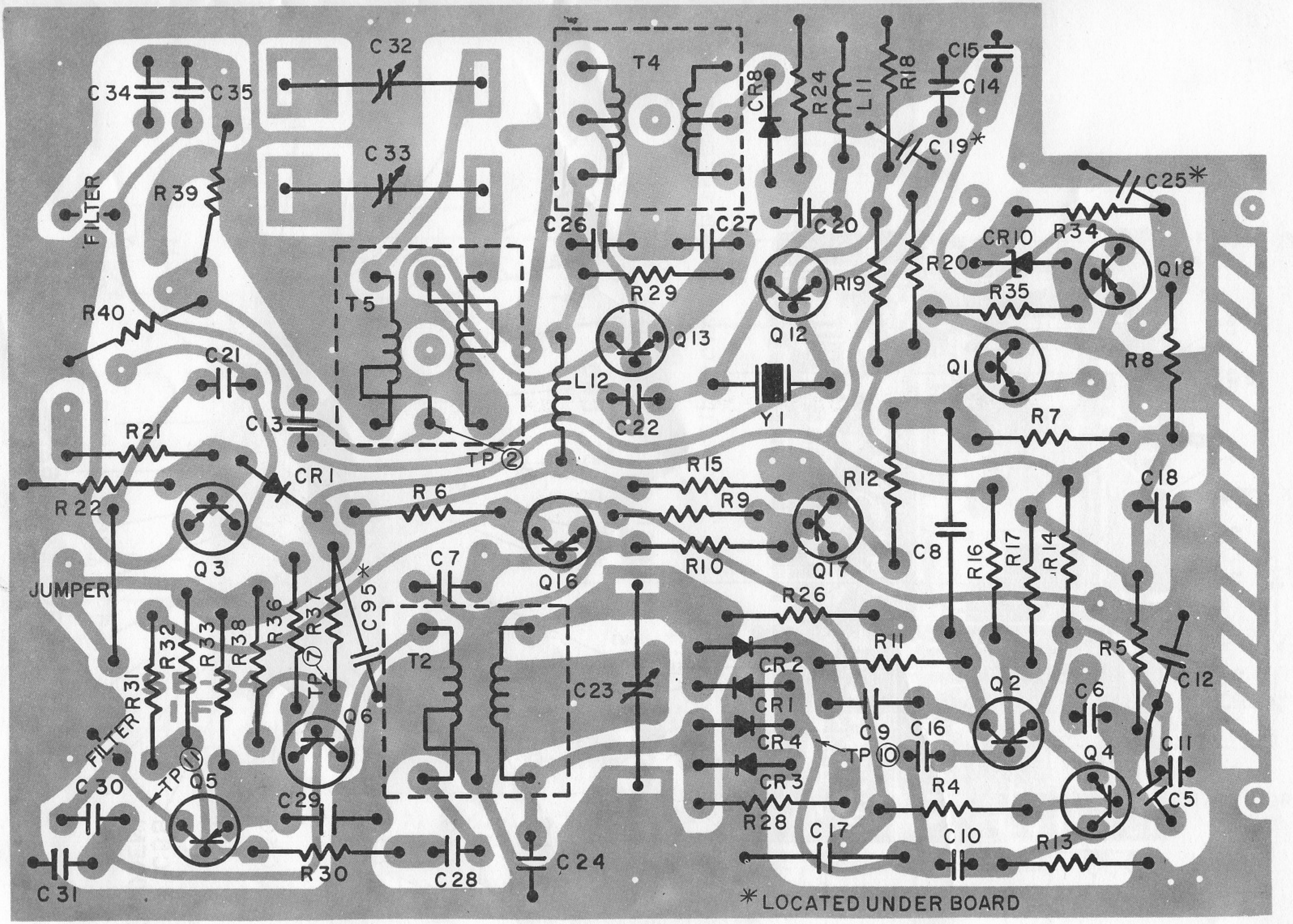
4.1 VFO BOARD



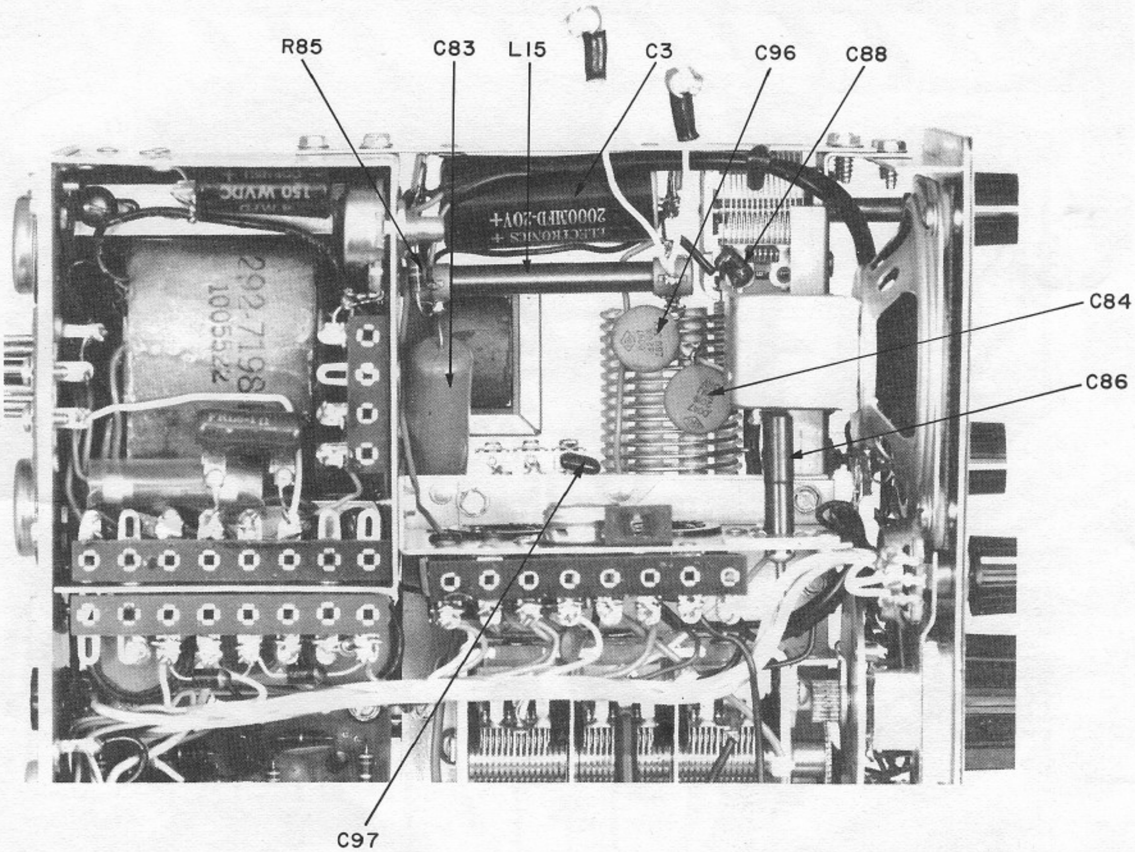
4.2 VFO BOARD BOTTOM


C11
C12
R17
R14
R7
C8
Q1
C5
C6
R5
C18
R16
R8
Q18
R34
R13
Q4
CR10
R35
Q2
C9
R12
C15
R4
C14
C10
R20
C16
R19
R11
R18
Q17
L11
R26
C20
C17
R24
R28
CR8
CR4, CR5,
CR6 & CR7
Q12
T4
C27
R10
R29
R9
C23
C26
R15
Q13
T2
C24
C22
T5
C28
L12
C7
Q16
R30
C32
C 29
C33
Q6
R6
Q5
C35
C34
R37
C30
R31
R38
Q3
R21
C13
C21
C31
R33
R32
R36
R22
CR1
R40
R39

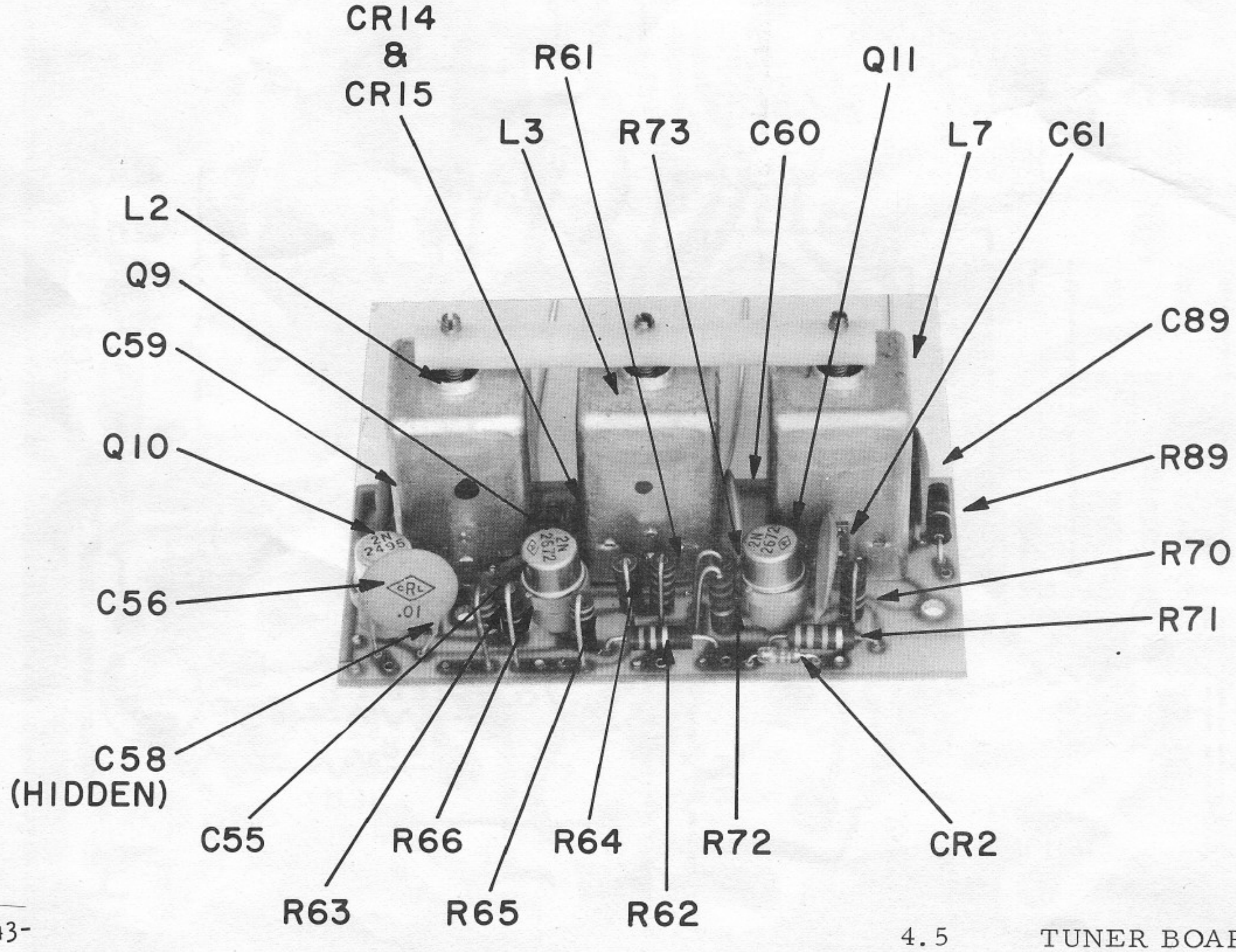
4.3 IF BOARD



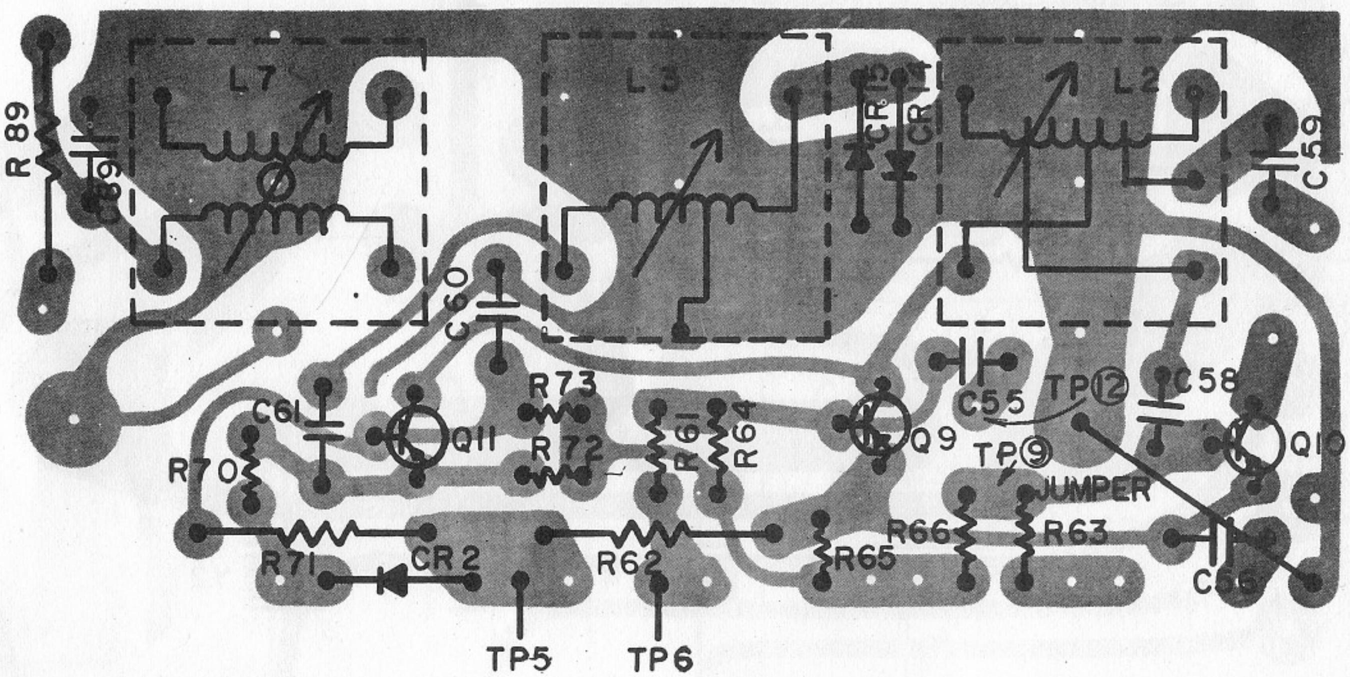
4.4 IF BOARD BOTTOM



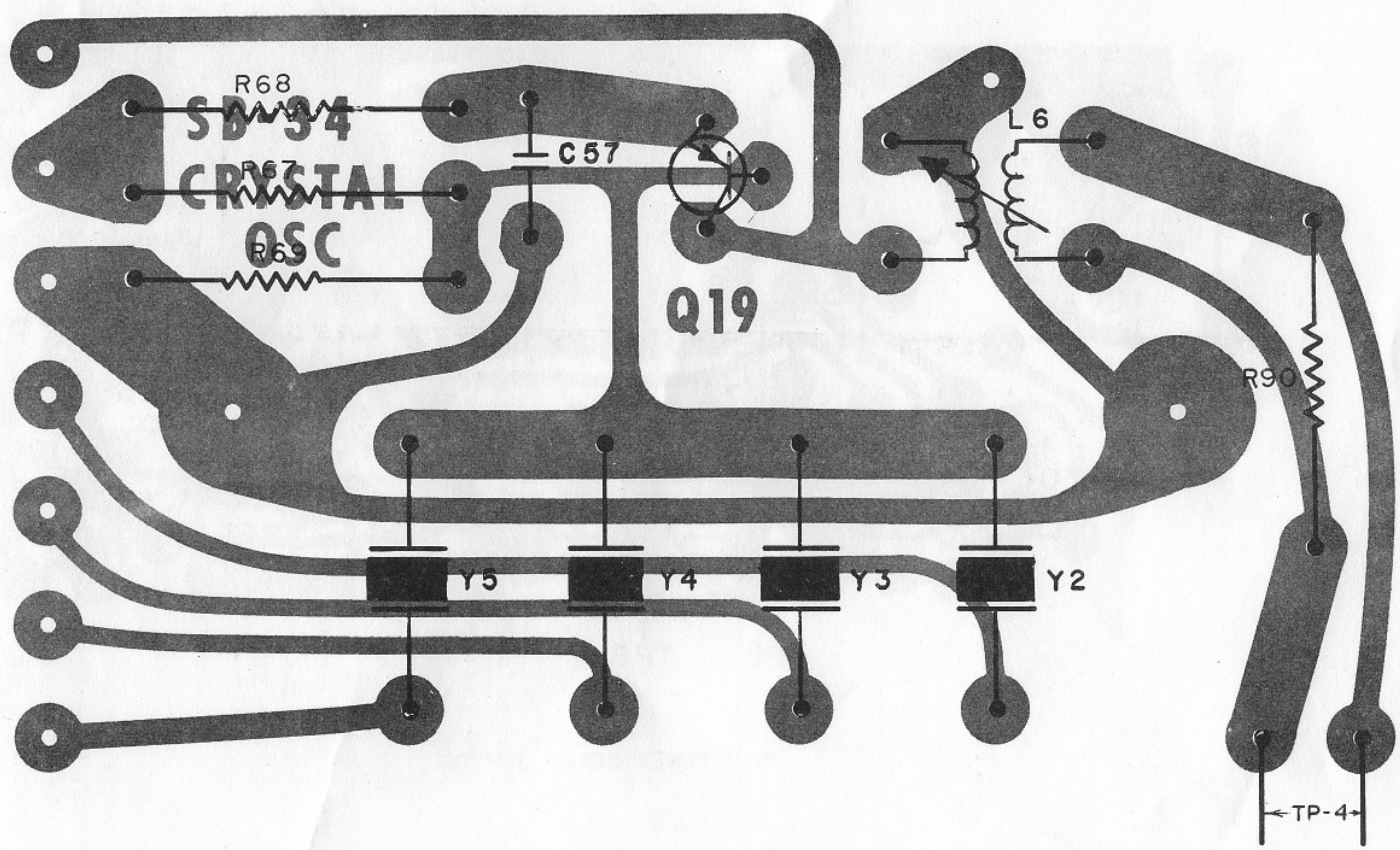
4.6 PA CAVITY WITH TUBES REMOVED



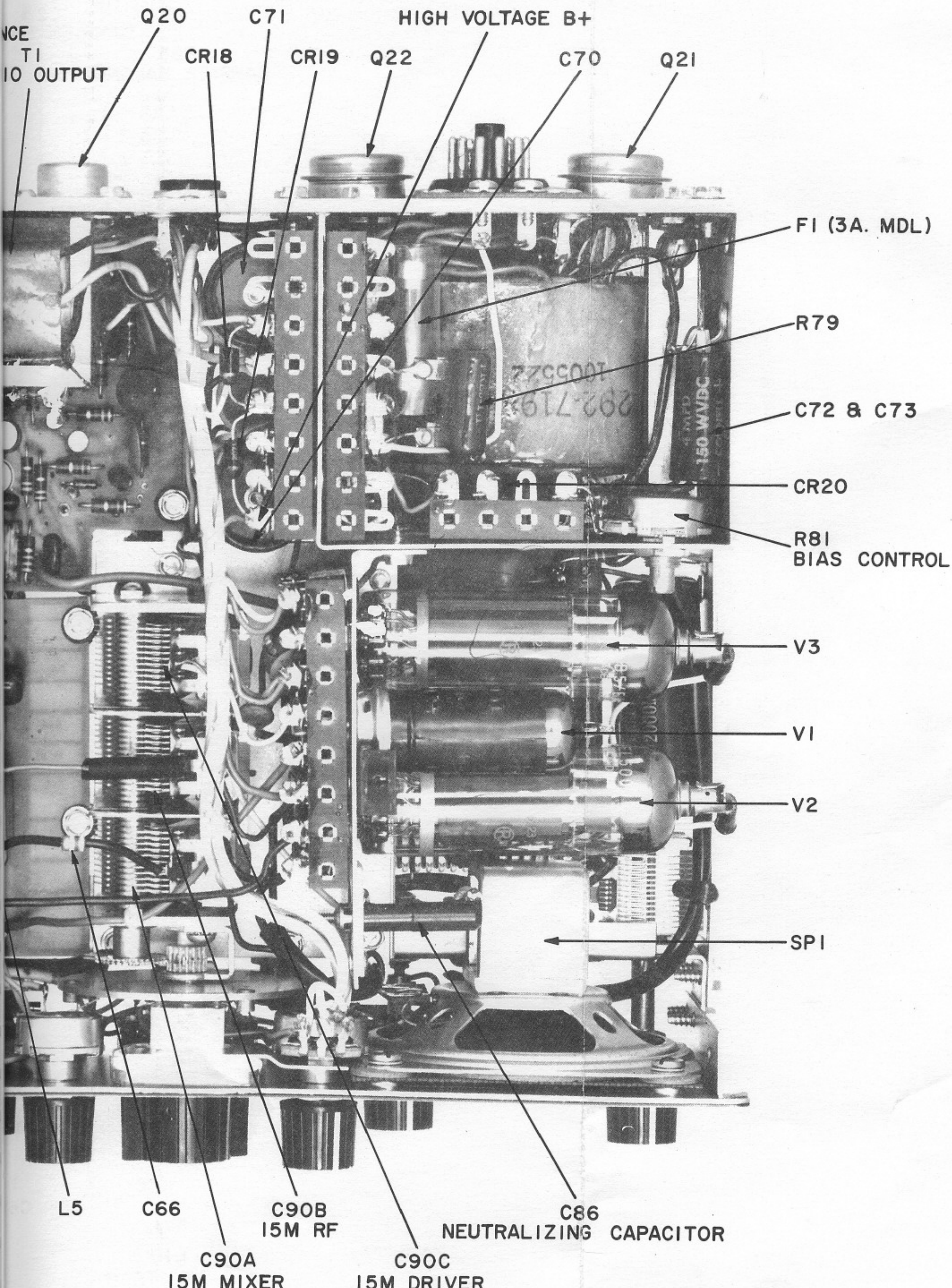
4.5 TUNER BOARD



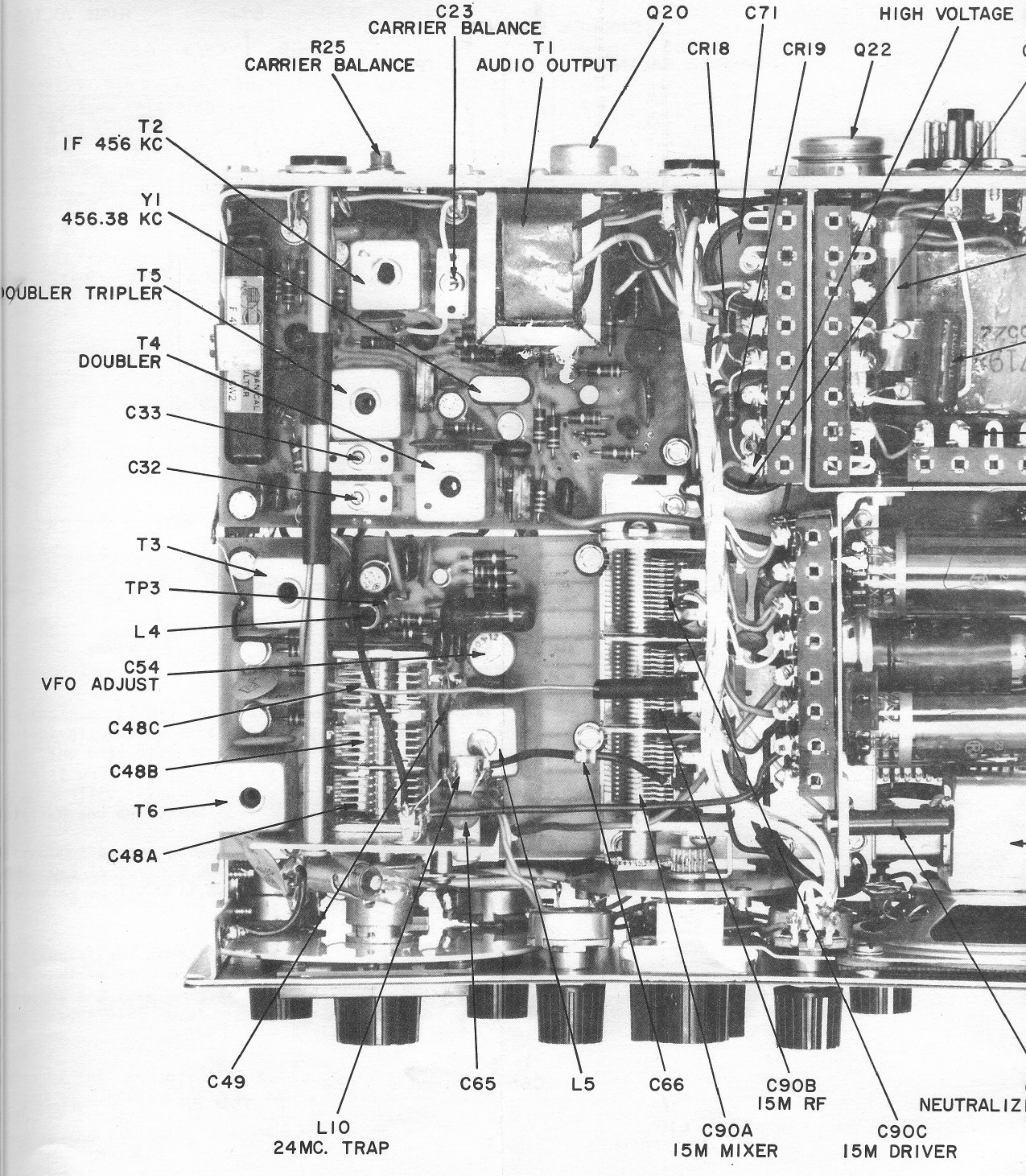
4.7 TUNER BOARD BOTTOM



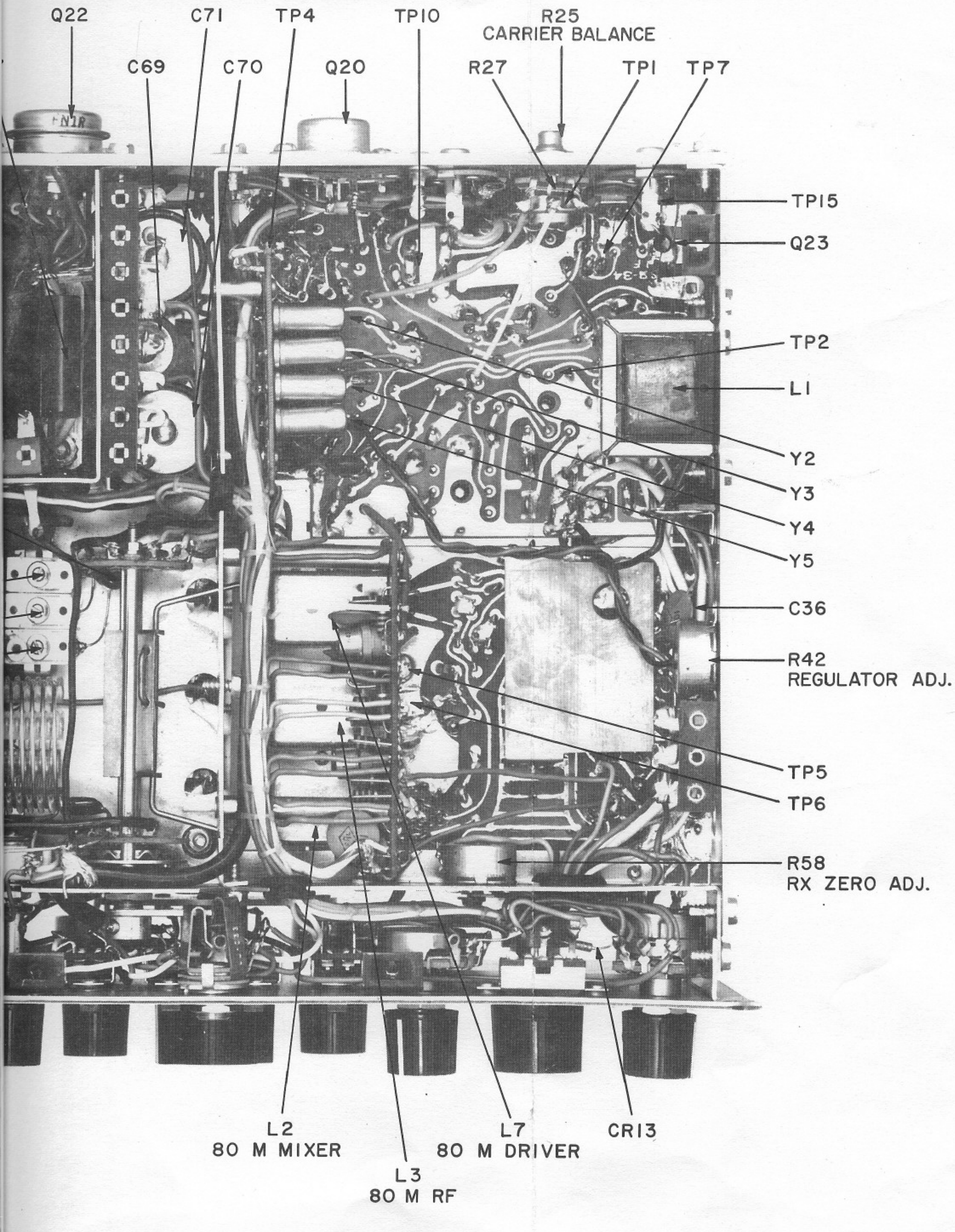
4.8 CRYSTAL OSCILLATOR BOARD BOTTOM



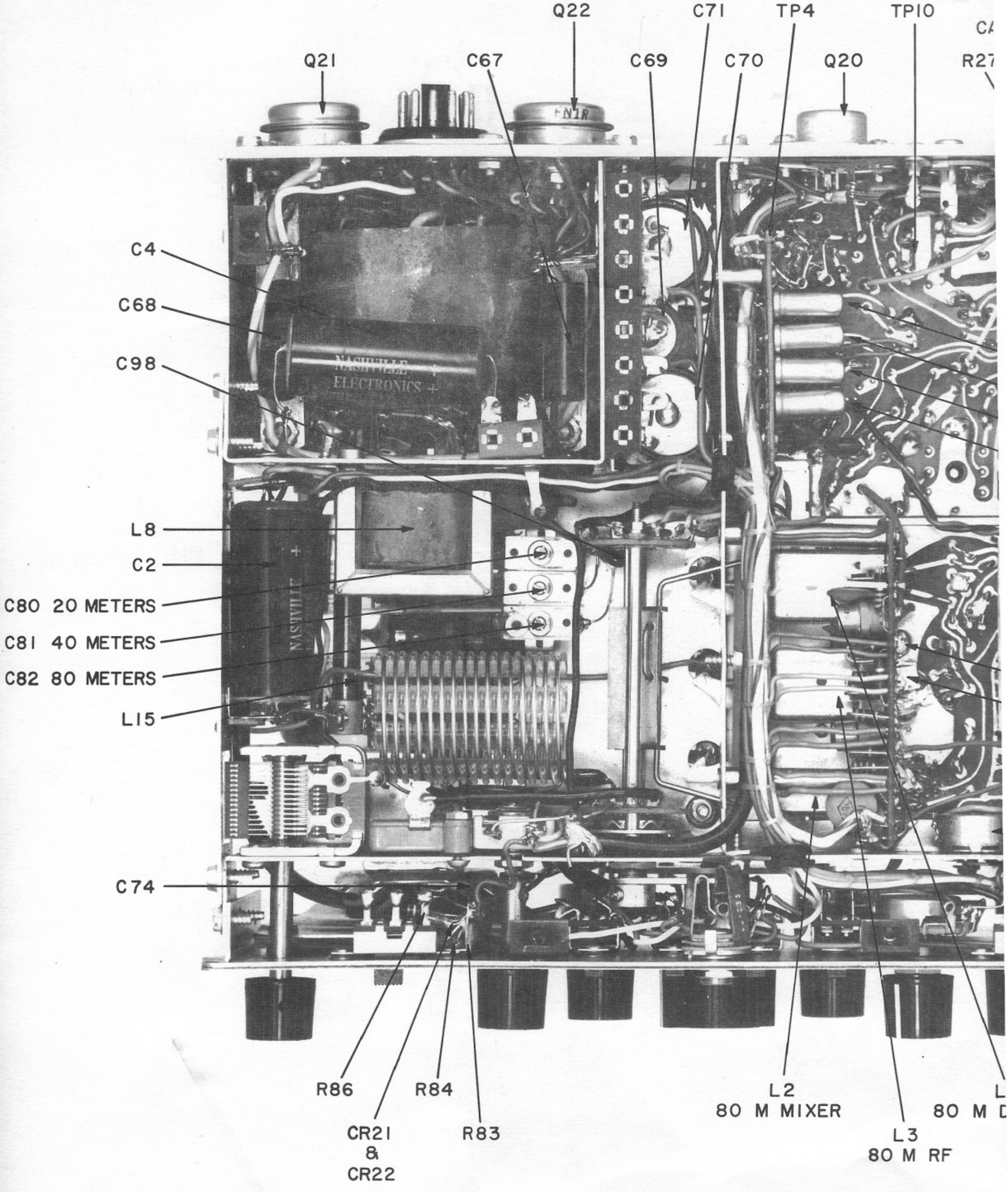
4.9 CHASSIS TOP VIEW



C23
CARRIER BALANCE
Q20
C71
HIGH VOLTAGE
R25
CARRIER BALANCE
T1
AUDIO OUTPUT
CR18
CR19
Q22
T2
IF 456 KC
Y1
456.38 KC
T5
DOUBLER TRIPLER
T4
DOUBLER
C33
C32
T3
TP3
L4
C54
VFO ADJUST
C48C
C48B
T6
C48A
C49
C65
L5
C66
C90B
15M RF
NEUTRALIZI
L10
24MC. TRAP
C90A
15M MIXER
C90C
15M DRIVER



4.10 CHASSIS BOTTOM VIEW


Q22
C71
TP4
TP10
Q21
C67
C69
C70
Q20
C4
C68
C98
NASHVILLE
ELECTRONICS
L8
C2
C80 20 METERS
C81 40 METERS
C82 80 METERS
L15
C74
R86
R84
L2
80 M MIXER
CR21
&
CR22
R83
L3
80 M RF

5. MODIFICATIONS

Modifications

5.1.1 The following change should be made if the range of the Dial Correct Control is insufficient in chassis #9 or below

ON THE VFO BOARD CHANGE:	PART NUMBER
a. R-57 to 1000 ohms, ½ watt, 10% Recalibration of the VFO will be necessary	280-1145-P74

5.1.2 If the microphone connector shorts against the rail directly behind it in chassis #12 or below, add a piece of insulating material to the rail assembly.

5.1.3 The following change should be made if failure of Q-16 or Q-17 occurs in chassis #13 or below.

ON THE IF BOARD CHANGE:	PART NUMBER
a. Q-16 and Q-17 to type 2N3642	386-7185-P1
b. R-10 to 680 ohms, ½ watt, 10%	280-1145-P68
c. R-9 to 3300 ohms, ½ watt, 10%	280-1145-P92

When making this change to chassis #7 or below, check to see that R-2 has been installed. (R-2 is located on the PA chassis)

d. R-2 is 220K ohms, ½ watt, 10%	280-1145-P158

5.1.4 The following change should be made if AGC failure occurs in chassis #15 or below:

ON THE IF BOARD CHANGE:	PART NUMBER
a. Q-3 to type 2N3642	386-7185-P1
b. R-22 to 4700 ohms, ½ watt, 10%	280-1145-P98

If a 27 ohm resistor is in series with C-21, it should be removed and a jumper wire installed in its place.

5.1.5 The following change should be made if the transmit and receive frequencies drift with respect to each other after initial warmup:

ON THE VFO BOARD CHANGE:	PART NUMBER
a. CR-12 to type 1N270	322-7186-P2

On the main chassis (between volume control and pitch switch) change:

b. CR-13 to type 1N270	322-7186-P2

Recalibration of the VFO and the receiver zero adjust pot. may be necessary.

5.1.6 If the microphone gain is insufficient in chassis #16 or below, make the following change to the IF Board:

	PART NUMBER
a. C-11 to 10mfd @ 12V electrolytic	235-7189-P4

5.1.7 Add AC fuse protection to chassis #17 or below:

		PART NUMBER
a.	3 amp MDL fuse	226-1009-P11
b.	Pigtail fuse holders	226-7175-P1

1. Break the junction of green and black wires on rear lug of terminal strip located top left in power transformer cavity.
2. Move green wire to vacant lug (fourth from front of terminal strip)
3. Install fuse between black and green wires and insulate with sleeving.

5.1.8 The following change should be made if failure of C-67 or C-68 occurs in chassis #18 or below:

	PART NUMBER
In the bottom of the transformer cavity, change C-67 and C-68 to 50 mfd @ 50V electrolytic	235-7215-P22

5.1.9 The following change should be made if the unit becomes erratic, intermittent or has an appreciable transmitter power fade after long warmup. This change will apply to chassis #19 and below:

ON THE IF BOARD CHANGE:		PART NUMBER
a.	R-30 to 10,000 ohms, ½ watt, 10%	280-1145-P110
b.	R-33 to 2200 ohms, ½ watt, 10%	280-1145-P86
c.	R-37 to 15K ohms, ½ watt, 10%	280-1145-P116
d.	C-29 to .1 mfd dipped mylar	235-7193-P7
e.	C-31 to 1000 pfd dipped mylar	235-7193-P1
f.	C-19 to .1 mfd dipped mylar NOTE: Locate the replacement capacitor on bottom of the PC Board	235-7193-P7
g.	C-25 to .1 mfd dipped mylar NOTE: Locate the replacement capacitor on bottom of the PC Board	235-7193-P7
h.	ADD (1) .01 capacitor disc ceramic NOTE: Locate on the bottom of the PC Board between junction of CR-1/R-37 and ground.	235-7207-P29

ON THE TUNER BOARD CHANGE:		PART NUMBER
a.	R-64 to 2200 ohms, ½ watt, 10%	280-1145-P86
b.	R-66 to 1500 ohms, ½ watt, 10%	280-1145-P80
c.	R-72 to 680 ohms, ½ watt, 10%	280-1145-P68

ON THE HF OSCILLATOR BOARD CHANGE:		PART NUMBER
a.	Q-19 to type 2N3638	386-7184-P1

ON THE MAIN CHASSIS ASSEMBLY ADD:		PART NUMBER
a.	(1) .0047 mfd, 3kv capacitor Connect in series with C-84 located in PA cavity above PA tank coil -- Designate C-96	235-7207-P25
b.	(1) 150 pfd, 300V dipped mica capacitor Connect in series with C-80 mica compression trimmer for 20 meter crystal -- Designate C-98	235-7053-P104

	PART NUMBER
c. (1) 150 pfd, 300V dipped mica capacitor. Connect in parallel with C-82 mica compression trimmer for 80 meter crystal -- Designate C-97	235-7053-P104

NOTE: Complete realignment will be necessary after this modification. High frequency oscillator coil L-6 may tune with the slug out of the coil.

5.1.10 The following change should be made if the microphone amplifier circuit or the receiver audio circuit shows signs of gain instability (motor boating - loud squeal when transmitter is keyed) in chassis stamped 21 or below.

ON THE IF BOARD CHANGE:	PART NUMBER
a. Q-2 and Q-4 to type 2N3638	386-7184-P1
b. R-5 and R-17 to 6800 ohms, ½ watt, 10%	280-1145-P104
c. Change wiring of C-5 from base to ground to base emitter	

5.1.11 The following change should be made if "Talk Back" occurs in chassis #23 or below:

	PART NUMBER
(1) Capacitor, 1 mfd, ceramic, disc. Connect capacitor between the emitter and base of Q-1 audio amplifier.	235-7207-P39

	PART NUMBER
5.1.12 Change C-69 to 100 mfd @ 350V. Change in all chassis stamped 23 and below.	235-7215-P33

5.1.13 The following change should be made if Vernier Drive failure is encountered in chassis number 26 or below:

ON THE MAIN CHASSIS CHANGE:	PART NUMBER
a. The Vernier Drive Mounting Bracket assembly to the new type.	726-5033-P1

PROCEDURE:

1. Remove all knobs from front panel.

2. Remove Dial Correct, Pitch, Volume, and Mike Gain Controls

3. Remove the two forward-most screws on both sides of the front panel and the one joining the upper right side to the top of the PA shield.

4. Loosen the two screws on the frequency dial collar.

5. Carefully pull the front panel away from the chassis along with the frequency dial.

6. Pull out far enough to allow the frequency dial to slip off the end of the Vernier Drive.

7. Remove the two screws on the Vernier Drive mounting collar. (Put screwdriver through the hole in the front panel left by the shaft of the Vernier Drive.

8. Remove the two set screws from the rear (brass) collar of the Vernier Drive unit and slip the entire unit off the shaft of the variable capacitor.

9. Remove the 24 megacycle trap from the support plate.

10. Remove the two mounting screws which fasten the variable capacitor to the mounting plate, the top support rod screw, and the two bottom chassis screws.

11. Remove the lamp and by-pass capacitor and discard the old mounting plate.

12. Install the new mounting bracket and replace all the mounting screws.

13. Slip the enclosed ¼ inch rubber grommet into the right-hand mounting slot on the new Vernier Drive assembly.

14. Install the new Vernier Drive by sliding the grommet over the brass shoulder pin protruding from the front of the mounting bracket. Tighten the screws in the rear brass collar of the Vernier Drive unit.

15. Reconnect all wiring and install the 24 megacycle trap.

16. Slip the frequency dial back over the shaft and move the front panel into place.

17. Replace lamp and by-pass capacitor.

18. Replace the controls and the five mounting screws; be sure the front panel is vertical.

19. Rotate the three gang capacitor to full mesh. Align the mark at the high end of the dial card with the hair-line of the window and tighten the screws on the aluminum collar. Be sure the dial is clear of all other parts.

20. Re-calibrate the unit; replace front panel knobs.

5.1.14 The following change should be made if power inverter interference is noticeable in the receiver while the unit is operating in the DC mode on chassis stamped 26 or below.

<u>ON THE IF BOARD CHANGE:</u>

a. Connect an appropriate length of number 14 <u>solid</u> insulated wire on the underside of the IF printed circuit board from the junction of CR-2/R-11 to the ground connection of C-12 on the perimeter of the PC Board.

b. Remove the rear/center hold-down screw on the IF PC Board and enlarge the hole to ¼ inch. Install extruded fiber washer (Part No. 236-1130-P1) between the mounting foot and the printed circuit board hole and replace the hold-down screw. The object of this arrangement is to prevent the printed circuit board from making ground contact at this point. After the above change has been installed, it is recommended that the carrier balance be checked and that T-2 be realigned.

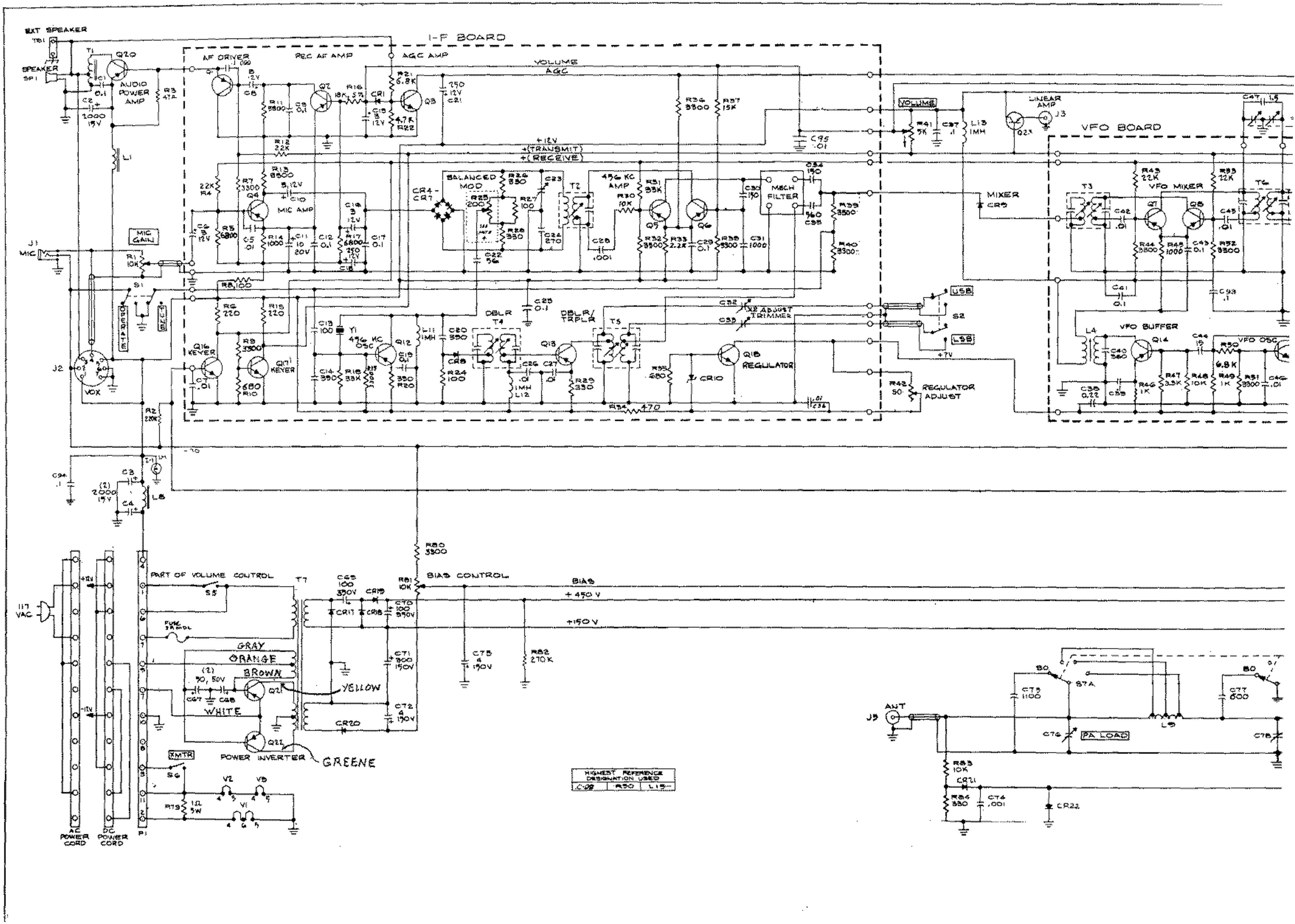
5.1.15 The following change should be made in all units exhibiting a drift characteristic in excess of 300 CPS per half hour. This change will apply to chassis number 28 or below.

ON THE IF BOARD CHANGE:	PART NUMBER
a. C-49 to 6.8 pfd, N-750	235-7219-P4
b. C-5 to 33 pfd, 5%, 300V, fixed mica (DM-15)	235-7053-P36
c. C-53 to 82 pfd, 2%, 500V, fixed mica (DM-15)	235-7053-P44
d. R-56 to 470 ohms, 10%, ½ watt	280-1145-P62
e. R-50 to 6.8K ohms, 10%, ½ watt	280-1145-P104
f. CR-11 to transistor type 2N3565 Only the base-collector junction will be used. Remove the emitter lead and insert the collector lead in the hole nearest the front panel left by the diode, the base lead in the rear hole.	386-7178-P1
g. Q-15 transistor to type 2N3564	386-7188-P1

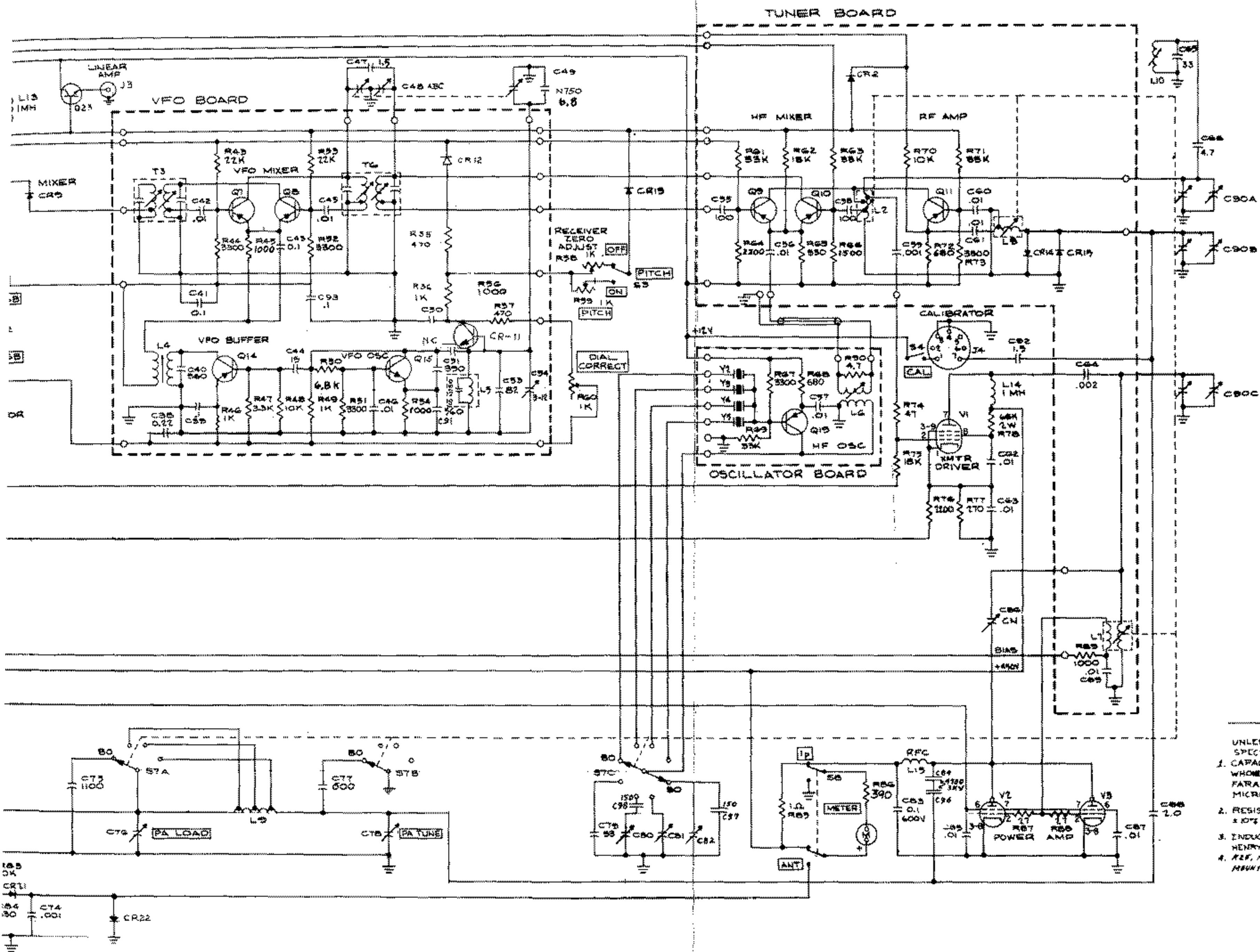
ON THE IF BOARD ADD:	PART NUMBER
a. 10 pfd, N-750 temperature compensating capacitor. Remove the VFO coil (L-5) from the printed circuit board. Remove the top screw and remove the coil from the can. Install a 10 pfd, N-750 temperature compensating capacitor across the coil terminals. Remove the yellow insulating material and discard. Reassemble the can making sure that the TC capacitor does not touch the side of the can. Glue a 1-3/4" piece of asbestos insulating material to the side of the can facing the PA tubes. Re-install the coil of the PCB. Perform the alignment steps 3.3.2.5 through 3.3.2.9. Re-check calibration with the crystal calibrator.	235-7129-P3

5.1.16 If receiver distortion is experienced in chassis stamped 22-27 or any units incorporating change 5.1.10, the following change should be made.

ON THE IF BOARD CHANGE:	PART NUMBER
a. R-16 to 33K ohms, 10%, ½ watt	280-1145-P92
b. ADD: R-91, 100K ohm, 10%, ½ watt	280-1145-P74
c. Connect from base of Q-2 to the collector of Q-17 in chassis stamped 28.	



EXT SPEAKER
TB1
SPEAKER
SP1
T1
Q20
AUDIO POWER AMP
R3 47Ω
C1 0.1
C2 2000 15V
L1
I-F BOARD
AF DRIVER
REC AF AMP
AGC AMP
VOLUME
AGC
Q1
Q2
Q3
R11 3300
R12 22K
R16 18K, 5%
CR1
R21 6.8K
R22 4.7K
C21 250 12V
R34 3300
R37 15K
C95 .01
+12V
+(TRANSMIT)
+(RECEIVE)
R13 3300
R4 22K
R7 3300
Q4
C10 5, 12V
MIC AMP
R5 6800
C5 .01
R14 1000
C11 10 20V
C12 0.1
R17 6800
C17 0.1
C16 250 12V
CR4 - CR7
BALANCED MOD
R25 200
R26 330
R27 100
R28 330
C23
C24 270
C22 56
T2
456 KC AMP
R30 10K
R31 33K
Q5
Q6
C28 .001
R32 3300
R33 2.2K
C29 0.1
R38 3300
C31 1000
C30 150
MECH FILTER
C34 150
C35 560
R39 3300
R40 3300
C25 0.1
MIC GAIN
J1
MIC
R1 10K
S1
R8, 100
R6 220
R15 220
R9 3300
Q16 KEYER
Q17 KEYER
R10 680
C7 .01
C13 100
Y1 456 KC OSC
Q12
C14 390
R18 33K
R20 330
L11 1MH
C20 390
CR8
R24 100
DBLR T4
C26 .01
C27 .01
L12 1MH
Q13
R29 330
DBLR/TRPLR T5
C32
C33
X2 ADJUST TRIMMER
Q15 REGULATOR
R35 680
CR10
R36 470
C36 .01
J2
VOX
R2 220K
VOLUME
R41 5K
C37 .1
L13 1MH
LINEAR AMP
Q23
J3
VFO BOARD
MIXER
CR9
T3
R43 22K
VFO MIXER
Q7
Q8
R53 22K
C42 .01
C43 .01
R44 3300
R45 1000
C43 0.1
R52 3300
C41 0.1
C93 .1
USB
S2
LSB
+7V
R42 50
REGULATOR ADJUST
L4
C40 560
VFO BUFFER
Q14
C44 15
R50
VFO OSC
6.8K
R47 3.3K
R48 10K
R49 1K
R51 3300
C46 .01
C38 0.22
C39
R46 1K
C47
T6
C94 .1
C3
(2) 2000 15V
C4
L8
R80 3300
R81 10K
BIAS CONTROL
BIAS
+450 V
+150 V
PART OF VOLUME CONTROL
S5
T7
117 VAC
+12V
-12V
FUSE
C65 100 350V
CR19
CR17
CR18
C70 100 350V
C71 300 150V
C72 4 150V
C75 4 150V
R82 270K
GRAY
ORANGE
BROWN
YELLOW
(2) 50, 50V
C67
C68
Q21
WHITE
CR20
Q22
POWER INVERTER
GREENE
XMTR
S6
V2
V3
V1
R79 1Ω 5W
AC POWER CORD
DC POWER CORD
P1
HIGHEST REFERENCE DESIGNATION USED
C-95
R-50
L-15
ANT
J5
C73 1100
S7A
L15
C77 600
C76
PA LOAD
C78
R83 10K
CR21
R84 330
C74 .001
CR22



NOTES

UNLESS OTHER WISE SPECIFIED:

1. CAPACITOR VALUES IN WHOLE NUMBERS ARE PICO-FARADS, DECIMALS INDICATE MICROFARADS,
2. RESISTOR VALUES IN OHMS ± 10% 1/2 WATT,
3. INDUCTOR VALUES IN MICRO-HENRYS (μh)
4. R2F, MOD. BAL. CONTROL IS NOT MOUNTED ON IF BOARD

SB-34 SCHEMATIC
5.2

J7267-8001 27

Symbol	Stock No.	Description
		CAPACITORS
C1, 39, 41, 43, 93, 99	235-7207P39	Ceramic, disc, .1mfd, 100V
C2,3,4	235-7215P43	Electrolytic, tubular, 2000mfd, 20V
C5,7,26,27,36, 42,45,46,50,56, 57,60,61,62,63, 85,87,89,95	235-7195P12	Ceramic, disc, .01mfd, 500V, GMV.
C6,10,15,16	235-7189P1	Electrolytic, tubular, 3mfd, 12V
C8	235-7215P1	Electrolytic, tubular, 3mfd, 12V
C9,12,37,94	235-7207P40	Ceramic, disc, .1mfd, 100V
C11	235-7189P4	Electrolytic, 10mfd, 20V
C13,55,58	235-7207P8	Ceramic, disc, 100pfd, 600V
C14,20,51	235-7053P313	Mica, dipped, 390pfd, 500V
C17,29	235-7193P7	Mylar, dipped, .1mfd, 100V
C18,21	235-7189P20	Electrolytic, tubular, 250mfd, 12V
C19, 25	235-7193P7	Mylar, dipped, 0.1mfd
C22	235-7207P6	Ceramic, disc, 56pfd, 600V
C23, 32,	235-7263P1	Variable, mica, compression
C24	235-7053P279	Mica, molded, 270pfd, 500V
C28	235-7207P14	Ceramic, disc, .001mfd, 600V
C30,34,97,98	235-7053P104	Mica, dipped, 150pfd, 300V
C31	235-7193P1	Mylar, dipped, 1000pfd, 100V
C35,40,91	235-7053P317	Mica, dipped, 560pfd, 500V
C38	235-7205P5	Mylar, dipped, .22mfd, 100V
C44	235-7196P61	Ceramic, disc, 15pfd, 500V
C47, 92	235-7200P6	Bakelite, tubular, 1.5pfd, 100V
C48A,B,C	235-7185P1	Variable, 3-gang VFO
C49	235-7196P9	Ceramic, disc, 6.8pfd, 10%, NPO
C52	235-7053P36	Mica, dipped, 33pfd, 5%, 300V
C53	235-7053P44	Mica, dipped, 82pfd, 2%, 500V
C54	235-7260P1	Ceramic, variable, 3-12pfd
C59,74	235-7207P14	Ceramic, disc, .001mfd, 500V
C64	235-7195P60	Ceramic, disc, .002mfd, 1KV
C65,79	235-7196P63	Ceramic, disc, 33pfd, NPO
C66	235-7200P4	Bakelite, tubular, 4.7pfd, 100V
C67,68	235-7215P22	Electrolytic, tubular, 50mfd, 50V
C69	235-7215P33	Electrolytic, tubular, 100mfd, 350V
C70	235-7215P33	Electrolytic, tubular, 100mfd, 350V
C71	235-7215P39	Electrolytic, tubular, 300mfd, 150V
C72,73	235-7215P3	Electrolytic, tubular, 4mfd, 150V
C75	235-7064P5	Mica, dipped, 1100pfd
C76	235-7267P1	Mica, variable, compression, PA load
C77	235-7210P7	Mica, "H" type, .0005 mfd, 10%, 2500V
C78	235-7186P1	Variable, PA tune
C80-81-82	235-7274P1	Mica, variable, compression, 3-sec.

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Jbly
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L tuning
Lswitch
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L C76
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L small
L power
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ly Parts
M2-3-7)
Prod, nylon
ire
: bracket
Q1, ball
Qit Board (less
Qr)

mc,

lmfd, 100V
ilar, 2000mfd, 20V
01mfd, 500V, GMV
ilar, 3mfd, 12V
ilar, 3mfd, 12V
lmfd, 100V
ifd, 20V
00pfd, 600V
0pfd, 500V
lmfd, 100V
ilar, 250mfd, 12V
lmfd
6pfd, 600V
compression
0pfd, 500V
001mfd, 600V
0pfd, 300V
000pfd, 100V
0pfd, 500V
22mfd, 100V
5pfd, 500V
1.5pfd, 100V
VFO
.8pfd, 10%, NPO
pfd, 5%, 300V
pfd, 2%, 500V
e, 3-12pfd
001mfd, 500V
002mfd, 1KV
3pfd, NPO
4.7pfd, 100V
lar, 50mfd, 50V
lar, 100mfd, 350V
lar, 100mfd, 350V
lar, 300mfd, 150V
lar, 4mfd, 150V
00pfd
ompression, PA load
0005 mfd, 10%, 2500V
e
ompression, 3-sec.

Symbol	Stock No.	Description
C83	235-7212P14	Paper, tubular, .1mfd, 600V
C84, 96	235-7207P25	Ceramic, disc, .0047mfd, 3KV
C86	235-7259P1	Ceramic, neutralizing
C88	235-7053P0	Mica, dipped, 2pfd, 500V
C90, A, B, C,	235-7184P1	Variable, 3-gang
		DIODES
CR1,2,4,5,6, 7,8,21,22	322-7186P3	Germanium, S262
CR9	322-7186P6	Germanium, 1N87A
CR10	322-7175P5	Zener, 7.0V, 5mA
CR11	386-7178P1	Transistor 2N3565
CR12,13	322-7186P2	Germanium 1N270
CR14,15	322-7184P2	Silicon, planar, HE9010
CR17,18,19,20	322-7180P1	Silicon, 1N2071
F1	226-1009P11	FUSE, 3amp, MDL
I-1	277-1013P1	LAMP, 28V, .17A bayonet
		SOCKETS
J-1	276-7195P1	Microphone
J2, 4	282-7185P1	Vox & Calibrator, 7-pin min. tube
J3, 5	276-7250P1	Antenna & Linear amp.
		COILS
L1	292-7200P1	Audio choke
L2	375-7223P1	Tuner (black dot)
L3	375-7223P2	Tuner (red dot)
L4	375-7260P1	VFO buffer
L5	375-7226P1	VFO
L6	375-7224P1	Crystal oscillator
L7	375-7223P3	Tuner (orange dot)
L8	292-7184P1	Filter
L9	375-7221P1	PA tank
L10	375-7183P1	23 mc trap
L11, 12	375-7274P1	RF choke, 1mh
L13, 14	375-7178P1	RF choke, 1mh
L15	375-7220P1	RF choke
M	245-7181P1	METER
P1	276-7269P1	PLUG, power
		TRANSISTORS
Q1	386-7224P1	2N2431
Q2, 4	386-7184P1	2N3638
Q3, 16, 17	386-7185P1	2N3642

Symbol	Stock No.
Q5,6,7,8,9,11, 12,13,14	386-7219
Q10	386-7223
Q15	386-7188
Q18, 23	386-7214
Q19,	386-7184
Q20	386-7200
Q21,22	386-7205
R1	240-7180
R25	240-7178
R41	240-7181
R42	240-7196
R58	240-7206
R59	240-7179
R60	240-7179
R79	280-1106
R81	240-7221
S1	228-7280
S2	228-7280
S3	228-7278
S4	228-7277
S5	
S6	228-7279
S7, A,B,C	228-7194
S8	228-7280
SP1	352-7177
T1	292-7199
T2	375-7222
T3	375-7222
T4	375-7222
T5	375-7222
T6	375-7222
T7	292-7198

oe
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ive
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mfd, 600V
047mfd, 3KV
zing
, 500V
A
E9010
MDL
7A bayonet
-pin min. tube
amp.

Symbol	Stock No.	Description
Q5,6,7,8,9,11, 12,13,14	386-7219P1	2N2672
Q10	386-7223P1	2N2495
Q15	386-7188P1	2N3564
Q18, 23	386-7214P1	2N2926
Q19,	386-7184P1	2N3638
Q20	386-7200P1	2N2869/2N301
Q21,22	386-7205P3	2N443 or AE443 Red
		RESISTORS
		All fixed resistors are 10% carbon, 1/2 watt unless otherwise noted on schematic.
R1	240-7180P1	Microphone Gain Control, 10KΩ
R25	240-7178P1	Carrier balance, 200Ω
R41	240-7181P1	Volume Control, 5000Ω w/switch S5
R42	240-7196P1	Regulator adjust, WW, 50Ω, 2W
R58	240-7206P1	Receiver zero adjust, WW, 1KΩ, 2W
R59	240-7179P1	Pitch control, 1000Ω
R60	240-7179P1	Dial correct, 1000Ω
R79	280-1106P1	Fixed WW, 1Ω, 5W
R81	240-7221P1	Bias control, 10KΩ
		SWITCHES
S1	228-7280P1	Tune-Operate, DPDT slide
S2	228-7280P1	USB-LSB, DPDT slide
S3	228-7278P1	Pitch OFF-ON, SPDT slide, .5-amp, 125V
S4	228-7277P1	Calibrate, SPST slide, 1-amp, 125V
S5		Part of R41
S6	228-7279P1	Transmitter, SPST slide, 10-amp, 125V
S7, A,B,C	228-7194P1	Rotary Switch Assembly
S8	228-7280P1	Meter, DPDT slide
SP1	352-7177P1	SPEAKER, 3.2Ω
		TRANSFORMERS
T1	292-7199P1	Audio output
T2	375-7222P1	IF, 456Kc (red dot)
T3	375-7222P4	IF, 2281.9Kc
T4	375-7222P2	Doubler (green dot)
T5	375-7222P3	Doubler/Tripler (yellow dot)
T6	375-7222P5	IF, 3350Kc
T7	292-7198P1	Power

Symbol	Stock No.	Description
		TUBES
V1	290-7247P2	12DQ7
V2, 3	290-7215P1	6GB5
		CRYSTALS
Y1	394-7189P1	456.38Kc
Y2	394-7185P1	7200Kc (80 meter)
Y3	394-7186P1	10475Kc (40 meter)
Y4	394-7187P1	17525Kc (20 meter)
Y5	394-7188P1	24625Kc (15 meter)
		MISCELLANEOUS
	7267-5005G1	Cabinet, complete w/handle
	7267-7012P1	Cable, DC, W-70
	7267-7013P1	Cable, AC, W-71
	7267-1065P1	Clamp, Mech. Filter
	7267-1045P1	Dial, Frequency
	7267-1027P1	Dial, Bezel
	7267-1028P1	Dial, Window
	7267-1047G1	Geneva Wheel assembly
	7251-1021G1	Geneva Plate assembly
	7267-1042P1	Grill, speaker
	231-7221G1	Handle, w/mounting clips
	231-7192P4	Knob, small round
	231-7196P2	Knob, large round, tuning
	231-7191P2	Knob, pointer, bandswitch
	369-7174P1	Mechanical Filter
	7267-1026P1	Panel, Front overlay
	7267-1035P1	Shaft, extension for C76
	7267-1063P1	Shield, top
	7267-1062P1	Shield, bottom
	7267-1064P1	Shield, VFO board
	386-7193P1	Socket, transistor, small
	386-7194P1	Socket, transistor, power
	282-7196P1	Socket, tube V-1
	282-7194P2	Socket, tube V-2-3
		Tuner Slug Assembly Parts
	297-7182P1	Ferrite slug (L-2-3-7)
	7251-1062P2	Slug connecting rod, nylon
	7267-1038P1	Yoke, wire
	7251-1024P1	Yoke Keeper, wire
	7251-1026P1	Yoke attachment bracket
	7267-1041P1	Vernier Drive, dual, ball
	7267-5016G2	I. F. Printed Circuit Board (less mechanical Filter)

			Q9 - Q10		Q7 - Q8			CR-9		CR-9
							Lower Sideband		Upper Sideband	
80 Meters	Receive Frequency	HF Crystal Frequency	HF Mixer Output	VFO Frequency	VFO Mixer Output	IF Crystal Frequency	IF Crystal Freq X 4	IF Mixer Output	IF Crystal Freq X 6	IF Mixer Output
	3775	7200	3425	5706.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	3800	7200	3400	5681.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	3825	7200	3375	5656.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	3850	7200	3350	5631.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	3875	7200	3325	5606.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	3900	7200	3300	5581.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	3925	7200	3275	5556.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	3950	7200	3250	5531.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	3975	7200	3225	5506.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	4000	7200	3200	5481.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	4025	7200	3175	5456.9	2281.9	456.38	1825.52	456.38	2738.28	456.38

							Lower Sideband		Upper Sideband	
40 Meters	Receive Frequency	HF Crystal Frequency	HF Mixer Output	VFO Frequency	VFO Mixer Output	IF Crystal Frequency	IF Crystal Freq X 4	IF Mixer Output	IF Crystal Freq X 6	IF Mixer Output
	7050	10475	3425	5706.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	7075	10475	3400	5681.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	7100	10475	3375	5656.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	7125	10475	3350	5631.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	7150	10475	3325	5606.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	7175	10475	3300	5581.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	7200	10475	3275	5556.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	7225	10475	3250	5531.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	7250	10475	3225	5506.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	7275	10475	3200	5481.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	7300	10475	3175	5456.9	2281.9	456.38	1825.52	456.38	2738.28	456.38

							Lower Sideband		Upper Sideband	
20 Meters	Receive Frequency	HF Crystal Frequency	HF Mixer Output	VFO Frequency	VFO Mixer Output	IF Crystal Frequency	IF Crystal Freq X 4	IF Mixer Output	IF Crystal Freq X 6	IF Mixer Output
	14100	17525	3425	5706.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	14125	17525	3400	5681.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	14150	17525	3375	5656.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	14175	17525	3350	5631.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	14200	17525	3325	5606.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	14225	17525	3300	5581.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	14250	17525	3275	5556.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	14275	17525	3250	5531.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	14300	17525	3225	5506.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	14325	17525	3200	5481.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	14350	17525	3175	5456.9	2281.9	456.38	1825.52	456.38	2738.28	456.38

							Lower Sideband		Upper Sideband	
15 Meters	Receive Frequency	HF Crystal Frequency	HF Mixer Output	VFO Frequency	VFO Mixer Output	IF Crystal Frequency	IF Crystal Freq X 4	IF Mixer Output	IF Crystal Freq X 6	IF Mixer Output
	21200	24625	3425	5706.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	21225	24625	3400	5681.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	21250	24625	3375	5656.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	21275	24625	3350	5631.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	21300	24625	3325	5606.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	21325	24625	3300	5581.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	21350	24625	3275	5556.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	21375	24625	3250	5531.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	21400	24625	3225	5506.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	21425	24625	3200	5481.9	2281.9	456.38	1825.52	456.38	2738.28	456.38
	21450	24625	3175	5456.9	2281.9	456.38	1825.52	456.38	2738.28	456.38